CALIFORNIA HIGHWAYS AND PUBLIC WORKS

JANUARY 1941

[illegible]EWAY SHOWING DIVIDED HIGHWAY, PAVED CHANNEL AND SEVERAL OVERHEAD STRUCTURES

(SEE ARTICLE IN THIS ISSUE)

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California

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$48,615,000 for State Major Project Construction in Highway Biennial Budget

By FRANK W. CLARK, Director of Public Works

RECOMMENDATIONS for allocations to major projects in the biennial State highway budet for the 93d and 94th fiscal years, uly 1, 1941, to June 30, 1943, were dopted by the California Highway 'ommission on December 31, 1940, nd have been submitted to Governor 'ulbert L. Olson.

The amount available for construcon and improvement throughout the tate, after deduction for administrave expense, for maintenance of the 4,000 miles of State highway, for ne one-half cent allocation to incororated cities, and for joint highway istricts, will be $48,615,000.

The sources of revenue for the conruction, maintenance and operation f State highways are:

1. The gas tax. 2. One-half the net evenues of motor vehicle fees after roviding for the maintenance of the lotor Vehicle Department and the alifornia Highway Patrol. 3. The se fuel tax or Diesel tax available for ridge construction. 4. Regular Fed-ral aid appropriated for the fiscal ears 1942 and 1943 by Congress. 5. aravan fees from the transportation f motor vehicles into the State.

SOURCES OF INCOME

The estimated amounts from these urces accruing to the State Highay Department for the two-year eriod are:

Gas tax, $73,000,000; motor vehicle es, $8,474,000; use fuel tax (Die-l), $1,300,000; Federal aid, $7,600,-)0; caravan fees, $226,000; total,)0,600,000.

These estimated revenues for the 3d and 94th fiscal years must cover l purposes included in the adminisation of State highways. These are: dministration, Traffic Engineering nd Special Investigations, Maintence, Highway Planning Survey, apital Investment (including shops, uipment and maintenance stations), one-half cent for incorporated cities, Engineering, both preliminary and construction, Joint Highway District, Rights of Way, Contingency Reserve, Landscaping, maintenance of the San Francisco-Oakland Bay Bridge, and Construction. Allocation of these revenues is made in accordance with the various provisions of legislative enactments requiring distribution to the north and south sections of the State, to primary and secondary highways, to cities, to joint highway districts and other functions mentioned above.

$18,400,000 FOR MAINTENANCE

Administration, cooperative highway planning and special study costs are estimated at $4,435,000. Maintenance of the highways, including maintenance and operation of the newly acquired Carquinez and Antioch bridges, is estimated at $18,-400,000. The one-half cent allocation to cities is estimated to amount to $18,250,000.

The total for these three items is $41,085,000, which, with further deductions of $700,000 for capital investments and $200,000 for joint highway districts, leaves a balance for all other functions of $48,615,000.

Distribution of this last amount is made for the various purposes provided by statute to the north and south county groups, to primary and secondary roads, including the necessary engineering, rights of way and contingencies, and is allocated to 547 items or projects.

INADEQUACY OF FUNDS

The greatest problem facing the State in the immediate future will be the improvement of a strategic system of roads for National defense and the construction of access roads to the cantonments, naval and military reservations planned by the Federal authorities within the State.

The results of surveys made in this State for the proposed improvements which would be required for the strategic road system indicate that approximately $150,000,000 will be required in California. In addition to this amount, a sum of about $13,000,-000 will be necessary for the construction of access roads.

The appalling inadequacy of funds which are available for highway improvement is clearly seen when these figures are compared with the anticipated Federal aid and gas tax and other revenues shown above.

The State Division of Highways is now engaged, at the request of the Federal Government, in making surveys of various military roads principally those providing access to cantonments, air fields, bombing fields, through military and naval posts, and artillery ranges, etc.

LOST TO CONSTRUCTION FUNDS

The cost of these surveys is defrayed from Federal aid appropriations already made but which must now be withdrawn from construction projects to which these funds were allocated. Authorization for application of Federal aid funds to such work was provided in the recent Federal Aid Act adopted by Congress.

Surveys and plan work are now under way on such projects as the access road from San Luis Obispo to Camp San Luis Obispo, from Monterey to Camp Clayton, from March Field to Riverside and on several roads serving the military and naval establishments in San Diego.

The State proposes that funds for constructing the greatly expanded facilities required for adequate service to the military movements of traffic, be provided by the Federal Government. Unless such additional appropriations are made by Congress

California Highway Commission group—Seated, left to right: Chairman Lawrence Barrett; Director of Public Works Frank W. Clark; Bert L. Vaughn. Standing—Secretary Walter T. Ballou; Iener W. Nielsen; Amerigo Bozzani; L. G. Hitchcock

and if the authorized Federal aid for the ensuing biennium must be applied to these projects, the recommended budget program for State highways will be seriously disrupted and State highway construction reduced.

A number of the highways designated as strategic or access roads by the United States Army authorities are existing units of the State Federal Aid System and therefore eligible to share in expenditures of the regular Federal Aid funds.

OLD BRIDGES A PROBLEM

Old bridges on the State highway system are still one of the major problems in the allocation of funds. In the addition to the State highway system in 1933 of some 6800 miles of county roads, the State took over in excess of 1000 bridges, many of which were built in the early days of road construction and are of light construction inadequate for present day loads.

At the present time 338 of these bridges are posted for limited loads and speeds because they are structurally inadequate to support legal loads safely. Many have reached the stage where reconstruction is imperative to assure safe operation of vehicles. The State is faced with an ultimate expenditure of about $30,000,000 to replace all of these inadequate structures.

Revenues derived from the use fuel tax or the Diesel tax are far from sufficient to reconstruct even those bridges which are in immediate need of improvement to prevent accidents. It has been necessary to allocate a large amount of major project funds for the reconstruction of bridges, and in addition to the budgeted items an amount of $500,000 has been set up for emergency construction, repair or replacement of bridges which have failed or are posted for less than legal loads.

The Federal aid portion of the revenues available for State highway construction is provided by appropriations made by Congress, and are for special and definite purposes to be distributed in accordance with Federal regulations and over which the Federal Government will exercise final approval. The Federal aid funds are therefore limited in their application, but in order to earn this material contribution to State highway construction, allocation of State funds to match such Federal aid is necessary and these funds are subject to the limitations imposed by the Federal regulations which include the possibility of direct application to the military roads previously referred to.

A tabulation of the major projects for the coming biennial period detailing the county, State highway route, location, and the cost of construction, including right of way, engineering and contingencies, follows:

(Continued on page 22)

Governor Olson Dedicates and Opens Arroyo Seco Freeway

By AMERIGO BOZZANI, State Highway Commissioner

CLIMAXING more than 25 years of dreaming and planning by visionaries and engineers, Governor Culbert L. Olson at noon on Monday, December 30, officially dedicated to public service the Arroyo Seco Parkway, the West's first freeway, connecting the cities of Los Angeles, Pasadena and South Pasadena.

Opening of California's most modern highway became a reality when Governor Olson and Sally Stanton, Queen of the 1941 Pasadena Rose Festival, cut a ribbon of roses of beautiful design strung across the parkway.

High dignitaries of the Federal and State governments and of the U. S. Army, together with officials of the County of Los Angeles and the three cities linked together by the parkway participated in the ribbon cutting which had been preceded on Saturday morning, December 28, by a symbolical and highly colorful ceremony staged in the Arroyo Seco. At the ceremony Chief Tahachwee of the Kawie Indians, whose ancestors lived in the Arroyo wilderness hundreds of years before the coming of Father Junipero Serra and his Franciscan mission builders, smoked the pipe of peace with Director of Public Works Frank W. Clark and to the beating of tribal drums relinquished the rights of his people in the Arroyo and formally transferred the property to the State.

FIRST FREEWAY IN WEST

A caravan of more than four hundred automobiles headed by army units and with E. Raymond Cato, Chief of the Highway Patrol, acting as grand marshal traveled over the new highway from the Los Angeles city hall to the site of the dedication ceremonies, where a crowd of more than fifteen hundred persons heard a program of speech making and witnessed the final act in the drama of ultra modern highway construction.

"This," said Governor Olson in his dedicatory address, "is the first freeway in the West. It is only the first. And that is its great promise to the future—the promise of many more freeways to come."

GOVERNOR CULBERT L. OLSON

Built at a cost of approximately five million dollars, the Arroyo Seco Parkway provides a six-mile unit of a direct nine-mile highway link between the business districts of Los Angeles and Pasadena. It also serves Highland Park, Lincoln Heights, South Pasadena, San Marino, and other adjoining areas.

The project admirably exemplifies the spirit of cooperation between the Federal government through the Public Roads Administration, the Works Projects Administration, the Public Works Administration, the State of California and the cities of Los Angeles, Pasadena and South Pasadena, which made possible the completion of this great undertaking and has given California its first modern freeway.

Of the parkway and its significance, Governor Olson said:

My fellow citizens:

We are gathered here to dedicate a new section of State highway. It is *only* 6 miles long. In average traffic the motorist will travel over it from one end to the other in 7, or 8, or perhaps 9 minutes. But in doing so he will have traveled from the very heart of Los Angeles, through Highland Park and South Pasadena, to the very heart of Pasadena. And he will have done it in easy, nerve-free comfort, and, *above all*, in SAFETY. All this is, to say the least, most extraordinary.

Nevertheless, I suspect that after a few weeks the average motorist using this parkway will have become so used to it that all recollection will soon fade from his memory of how difficult, how tiring, and slow, not to say dangerous, it was to drive between Pasadena and Los Angeles.

Therefore, before we start using this road (and it will surely have heavy use on New Year's Day) it is

Official party at the ribbon cutting ceremony of the Arroyo Seco Freeway dedication—Left to right, Amerigo Bozzani, Highway Commissioner, Chairman of the Celebration Committee; Director of Public Works Frank W. Clark; Sally Stanton, Queen of the 1941 Rose Festival; Governor Culbert L. Olson; Larry Barrett, Chairman, Highway Commission and Ray Cato, Chief, State Highway Patrol

proper and timely, a *very* good thing, in fact, for us to pause a few moments—NOW—to ceremonialize and celebrate an achievement so extraordinary as the completion of this, the Arroyo Seco Parkway.

GREATER THINGS AHEAD

Let us briefly consider what has been done here, and why, and what it means to the community. Let us do this before it fades from memory. Let us do this before we rush headlong into the accomplishment of even greater achievements—for that is exactly what we shall soon be doing, because, in large part, of the knowledge and experience gained here.

In dedicating this Parkway we do honor to the men and women in whose dream, so long held and so long pursued, it had its inception. The story of that dream is full of interest because it parallels and bears practically the same dates as the story of the automobile. The dream, the idea of an Arroyo Seco highway gathered strength with the years. Its growth paralleled and matched the growth of the use of automobiles.

I wonder what sort of road Mr. T. D. Allen had in mind when he made the first survey for a road through here 45 years ago, when there could scarcely have been more than a hundred automobiles in the entire country. I wonder what report he made, and what recommendations—if any. Did he have in mind a winding, rustic, tree-shaded road, crossing and recrossing the creek bed which was (and is) dry most of the year? Or did he have his mind on more practical matters—such as a road to develop a string of gravel pits to supply sand and gravel to the builders of a greater and still greater Los Angeles?

Forty-five years between the first survey and today's splendid completion. That is a long time.

But perhaps it is just as well that the dream was a long time in its dreaming. Perhaps it is just as well that many obstacles stood in the path to its final realization. Perhaps it is just as well that the dream had to wait, and wait—wait until, under the pressure of sheer necessity, it finally burst out of the confining walls of public indifference, official inertia, selfish opposition, and narrow vision. It is just as well because, while confined, the dream grew and matured. So, when that dream was translated into legislation, that legislation was well conceived and broad visioned. And when the engineers were finally told to go to work, their working plans were BOLD and comprehensive, and they have given us something worth while.

I say BOLD because they were just that. They dealt boldly and realistically and *EFFECTIVELY* with a traffic problem that had become almost terrifying in its urgency of solution. Now that we have it, and it all looks so rather simple, so obviously necessary, so wholly practical, some there will be who will ask, "What is there so wonder-

At top—Part of the throng of people who attended the official dedication of the Arroyo Seco Freeway. Below, at left, automobiles moved to and from the dedication scene in six lanes demonstrating the facilities of the divided parkway for accommodating a heavy flow of traffic. Lower right—Governor Culbert L. Olson's car leads the long procession to the site of the official opening ceremonies on December 30th ful, or so bold about it?" Oh yes—but it takes courage to do a thing the FIRST time, no matter how necessary, no matter how simple and obvious it may appear AFTER it is done. And *this*, fellow citizens, is the *first* Freeway in the West.

HONOR TO ENGINEERS

In dedicating this Freeway, we do honor to the engineers (civil engineers, safety engineers, landscape architects, and human engineers) whose imagination, knowledge, skill and genius for organization and cooperation were poured into the conception, planning and execution of this great work. They built this freeway, using steel and concrete. But to these materials they added those indispensable ingredients imparted only by the mind; namely, adequacy, safety, economy and sheer beauty.

They built adequacy into this Freeway. It will take good care of the heavy traffic it will have to carry—for many years to come.

They built SAFETY into this Freeway. Safety, but at the same time ease, comfort and great speed, for the thousands of motorists who will pass this way every day. Safety for the children who live and play in the neighborhoods through which the freeway passes. And peace of mind for their parents. This one ingredient, alone, is priceless and would justify the entire cost of the project, because we have only to capitalize the expense, pain, tears and deaths which would result from the accidents which will be avoided by the use of this Freeway.

AN ECONOMICAL UTILITY

They exercised economy in the use and disposition of materials; an economy which has served to keep the cost of the project well below its utility value to the community. This utility value is measured not only by the accidents averted but also by the direct savings realized by the motorists, in terms of time, jangled nerves, gas and oil, and general wear and tear.

Use of the Freeway will free neighborhood streets and boulevards from the congestion of heavy through traffic, with corresponding improvement of the parking problem, greater quiet for the home owner, greater safety for the neighborhood and profit for the local merchant.


View of Arroyo Seco Freeway looking toward Pasadena showing 5 of 26 bridge structures

And lastly, our engineers and echnicians have invested the Arroyo Seco Parkway with *beauty* as vell as adequacy, safety and economy. Of course, beauty is only or him who has the eye to behold. But I ask you to look again, and gain at the very curves in this oadway. They are designed strictly for functional and utilitarian urposes, and banked for safety. They of course delight the engineer, he safety man, the road builder, he motor car manufacturer and the notorist himself, but they also delight the eye of the artist.

BEAUTIFUL VISTAS PRESERVED

Already we see proof of the careul planning for roadside beautification. Grass, flowers, shrubs and rees will soon cover bare banks and illsides, line the parkway, and nask the harsh lines of man's socalled improvements to the landcape. When they have grown to naturity, the experience of driving hrough Arroyo Seco Parkway vill be filled with the pleasure of reath-taking scenery, with a new nd beautiful vista opening at each urve of the road.

Let us, by all means, preserve hose vistas by holding them free rom commercial advertising signs. am happy to know that the WPA as set aside $300,000 for a stateponsored project for the further beautification of the Arroyo Seco.

I said, a few minutes ago, that his is the first Freeway in the West. t is ONLY the first. And THAT s its great promise to the future— he promise of many more freeways to come.

Very soon, this one will be extended 3 more miles closer to the heart of metropolitan Los Angeles, vith direct access to the Civic Center by way of Figueroa Street, and o Sunset Boulevard.

MANY MORE FREEWAYS

Very soon the Cahuenga Freeway vill be completed, eliminating the ast serious strictures upon fast, afe passage between Hollywood and San Fernando Valley and oints north.

Work is going forward rapidly on the great Olympic Boulevard project leading from Los Angeles' commercial center westerly to Santa Monica.

And in the San Francisco Bay listrict, definite plans are now in preparation to convert the Bay

Arroyo Seco Freeway looking toward Los Angeles. Note paved channel on left who introduced and secured passa of the legislation enabling the co struction of the Arroyo Seco Par way. I am proud of my own su port of this legislation.

Finally, I wish to say that t people of California are happy a grateful for having a benefice National Government which paid major portion of the money cost this project.

And now, in the name of t people and the State of Californi I hereby accept for them the A royo Seco Parkway and dedicate to the general service and safety the community.

TOO ILL TO APPEAR

It was regrettable that illness pr vented the appearance of Dr. L. Hewes, Chief of the Western Regi of the U. S. Public Roads Admini tration, without the assistance which agency the parkway could n have been built. Dr. Hewes was re resented by C. H. Sweetser.

With Frank C. Balfour of t Division of Highways acting as ma ter of ceremonies, the program speeches was opened by an invoc tion delivered by Rt. Rev. Bertra Stevens, B. D., Bishop of Los A geles. Mayor Andrew O. Porter the City of South Pasadena gave a

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Arroyo Seco in flood period before construction of paved control channel

Shore Highway into a Freeway from Palo Alto to San Francisco. And a similar undertaking is planned between San Jose and Oakland.

There is another feature about this Parkway that appeals strongly to me. It is this. Here is a great public work, unquestionably necessary, practical, and beneficial, but of great magnitude and cost. It stands as convincing proof that government can do things, practical and necessary things, and that it can do them in a businesslike and efficient manner.

ASSEMBLYWOMAN MILLER PRAISED

I have seen the printed pamphlet describing this Freeway. On the last inside page tribute is paid to the many men and women and organizations whose direct labors and cooperation spelled out the great and successful work we here dedicate. I wish to add thereto my own tribute.

I wish, also to tender praise to Assemblywoman Eleanor Miller

Director of Public Works Frank W. Clark smoking peace pipe with Kawie Indian Chief

Future Freeway Construction Depends Upon People of California

By FRANK W. CLARK, Director of Public Works

FREEWAYS are rapidly becoming an integral and necessary part of any comprehensive highway system. They are a natural and logical step in the gradual evolution of highway development—an evolution that dates back to the first use of the automobile. In retrospect, the speed of early automobiles in comparison with the horse and buggy brought on demands to take the highways out of the mud and ruts. These demands were met by surfacing the old wagon trails. Increased speeds and increased weights of trucks soon demanded straighter and smoother roads. Volumes of traffic increased until it was necessary to construct multi-lane highways.

Highways carrying large traffic volumes were soon recognized as an ideal point of contact between merchant and consumer. As soon as a new road was built "string towns" or "ribbon cities" would "mushroom" over night. Service stations, night clubs, fruit stands, junk yards and other commercial establishments were thrown up with utter disregard for aesthetics or of the purpose for which the road was built. As a result, the modernized highway facility which the motorist had paid for out of gas tax funds, often became little more than an ugly city street serving a few local interests. For the sake of safety, these roads had to be zoned for restricted speeds. In many cases the final result was a facility little better than the one which the new improvement had been built to replace.

Under the then existing laws, the Division of Highways was powerless to do anything about the situation. Now, however, the "Freeway Law" which was passed by the legislature in 1939 and approved by Governor Culbert L. Olson makes it possible to avoid these bottlenecks and places this State among the highway leaders of the nation.

The new law recognizes a freeway as a new type of a highway to which abutting property shall have no right of access or only limited right of access. Under this law, the department is authorized to acquire the necessary rights of way and rights of access from private property to construct and maintain such freeways. The intersection of local county roads or city streets can be regulated or eliminated by agreement with local authorities. New intersections of local streets or highways can not be made without the consent of the California Highway Commission.

FRANK W. CLARK

As a result of this law, projects such as the Arroyo Seco Parkway are now possible. This parkway with its dividing strip to separate opposing traffic throughout its length, with all cross traffic or left turn eliminated by grade separations and with strategically located ramps to permit rapid ingress and egress to and from the highway with a minimum of hazard, is typical of what can and is being accomplished. Where before, cross roads, private entrances, random turning and restricted speed zones often reduced the average speed of travel to 10 or 15 miles per hour, freeways will now permit safe average speeds in excess of 45 miles per hour.

Thus the highway transportation system has developed in gradual stages from the old wagon road to the modern freeway. These stages were all natural developments coming about as a result of popular demand.

While freeways are perhaps a panacea for most traffic ills, for practical reasons their use must be restricted to highways of great importance. Such highways usually occur in or near urban areas where land is subdivided into numerous small parcels which are ordinarily highly developed. The cost of this highly developed land to the widths necessary for freeways will often put the cost of rights of way in excess of that necessary for construction. Where a modern multi-lane highway in an urban area might cost $200,000 per mile, a freeway with its wide right of way, access rights, grade separations, service roads and connecting ramps may run to several times that cost. In rural areas the costs of both types of facility are proportionately lower.

It is only on a small mileage of our entire highway systems that freeways will be economically justified or for that matter will multi-lane highways be justified. The balance of the mileage, however, could absorb more than all available funds just to keep ahead of obsolescence. Thus, unless present highway revenues are markedly increased, expansion of the freeway system is almost certain to lag behind the demand.

To date the California Highway Commission has designated a total of 91.4 miles of highway as freeways.

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Two-yard power shovel removing 50,000 cubic yards deposit of beach sand on a bench 90 feet above coast highway

Eliminating 2-Lane Coast Link

By C. N. AINLEY, Resident Engineer

THE completion of a section of new four lane divided highway, built to modern standards of alignment and grade and replacing one of the bad stretches of the old coast road in Los Angeles County is scheduled for completion in February.

This heavily travelled route, known popularly as the Roosevelt Highway, will have remaining, only three and a half miles of two lane pavement between Santa Monica and Oxnard.

First located in 1921, the original highway was constructed and opened to traffic in 1929. Since that time continually increasing traffic has demanded a faster and safer highway, and as funds were available this route has been reconstructed to meet the demand.

The portion of the old road between Walnut Canyon and Solstice Canyon was narrow and had a number of short radius curves with restricted sight distances. The heavy traffic, with a high percentage of trucks, found this a hazardous stretch of road.

A contract for the relocation and reconstruction of this portion of the highway was awarded in October, 1939, to John Strona of Pomona, and work was started at once. An article by William H. Mohr in the April, 1940, issue of "California Highways and Public Works" magazine covered the salient features of the contract as they had appeared up to that time. Since then developments have caused the extension of the time limit 87 days, indicating the increased work encountered.

Sand pockets were found in a number of cuts and slides occurred in several others, making it necessary to flatten the slopes, and resulted in a large increase in roadway grading quantities. On the whole contract the roadway excavation was increased by 130,000 cubic yards.

When the contractor began operations on the west bluff of Railroad Slide a large deposit of beach sand was discovered on a bench 90 feet above the highway. This sand had a maximum thickness of 80 feet and was overlaid with a 20 foot cap of volcanic breccia. The increase in quantities outside the original one-half to one slope at this location alone amounted to 50,000 cubic yards.

The sand had to be removed before the work on the bluff could proceed. A dragline bucket was used to drag

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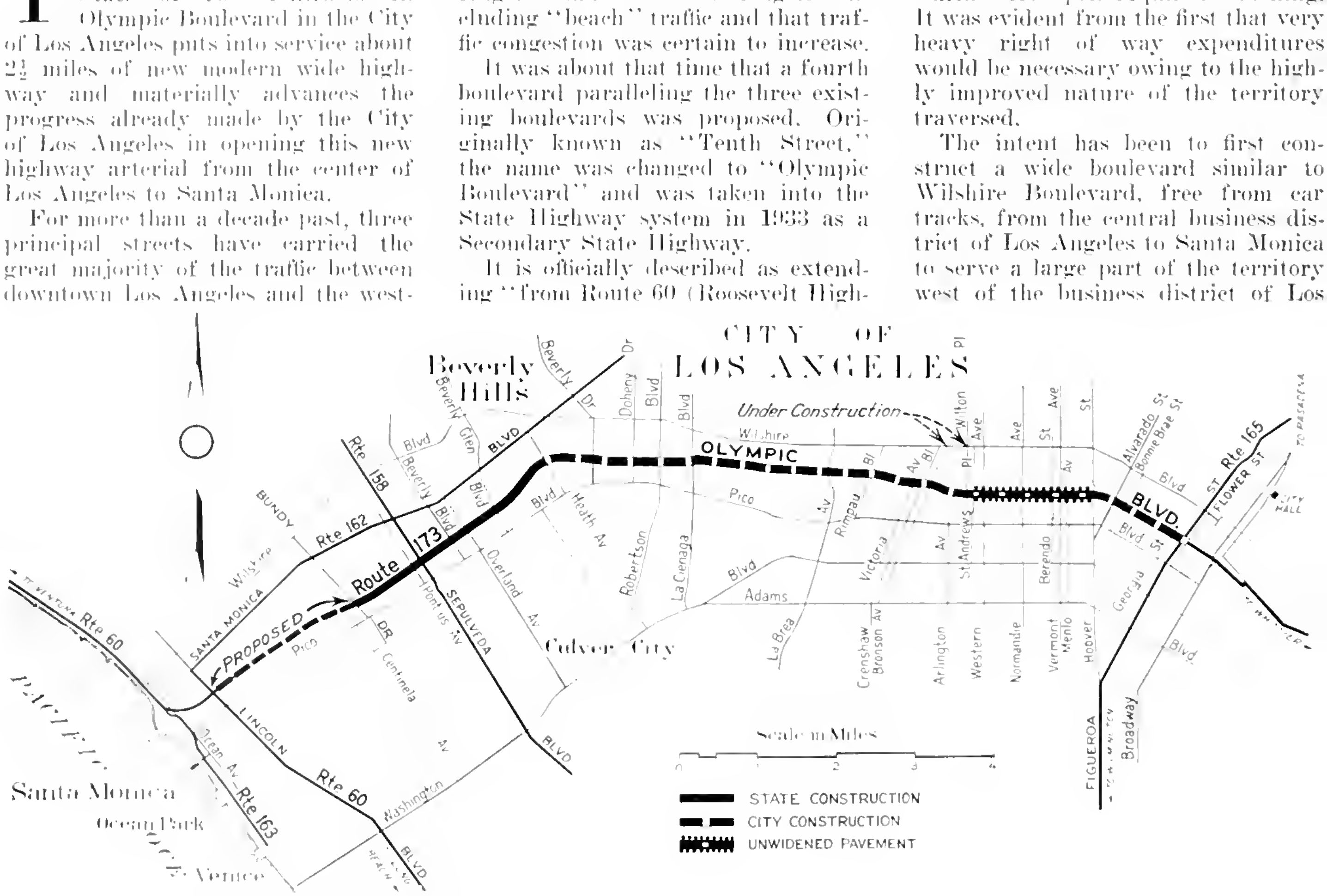
Sections of four-lane divided highway being completed on Coast Highway between Santa Monica and Oxnard

Two Olympic Boulevard Units Completed In Los Angeles City

By R. C. MYERS, Assistant District Office Engineer



Sketch map showing progressive construction of Olympic Boulevard through Los Angeles to the Coast Highway at Santa Monica

THE recent completion by the State of two contracts on Olympic Boulevard in the City of Los Angeles puts into service about 2½ miles of new modern wide highway and materially advances the progress already made by the City of Los Angeles in opening this new highway arterial from the center of Los Angeles to Santa Monica.

For more than a decade past, three principal streets have carried the great majority of the traffic between downtown Los Angeles and the westerly portion of Los Angeles and the beach city of Santa Monica. These streets, Santa Monica Boulevard, Pico Boulevard, and Wilshire Boulevard, were becoming increasingly more crowded. Street car lines on Pico and Santa Monica Boulevards greatly hampered traffic for some distance westerly of the center of Los Angeles.

Wilshire Boulevard was designed for and has carried a very heavy flow of traffic, but it became evident by about 1928 that the then existing boulevards were inadequate for the extremely heavy traffic between Los Angeles and West Los Angeles including "beach" traffic and that traffic congestion was certain to increase.

It was about that time that a fourth boulevard paralleling the three existing boulevards was proposed. Originally known as "Tenth Street," the name was changed to "Olympic Boulevard" and was taken into the State Highway system in 1933 as a Secondary State Highway.

It is officially described as extending "from Route 60 (Roosevelt Highway) in Santa Monica to the intersection of Ninth and Indiana Streets in Los Angeles via Tenth Street," this latter terminus being at the easterly city limit of Los Angeles.

HEAVY RIGHT OF WAY COSTS

The greater portion of the route was unimproved at that time and the improved portions were too narrow for the heavy traffic such a route would have to carry. There were several jogs in the alignment which required "smoothing out" and practically all of the portions of the route which were open required widening. It was evident from the first that very heavy right of way expenditures would be necessary owing to the highly improved nature of the territory traversed.

The intent has been to first construct a wide boulevard similar to Wilshire Boulevard, free from car tracks, from the central business district of Los Angeles to Santa Monica to serve a large part of the territory west of the business district of Los Angeles as well as through traffic between Santa Monica and Los Angeles. From progress already made it seems probable that the major part of this enterprise will be an accomplished fact by the end of the biennium 1941-43.

TWO STATE CONTRACTS

The two contracts handled by the State were from Beverly Glen Boulevard to Pontius Street and from Pontius Street to Bundy Drive in West Los Angeles. The lengths are 1.26

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Olympic Boulevard route bisects Twentieth Century-Fox Studio making it necessary to build bridge to connect studio buildings

This Olympic Boulevard unit has 4 twelve-foot lanes of asphaltic concrete, 2 eleven-foot lanes of Portland cement concrete

Tolls Reduced Approximately 20% On Carquinez And Antioch Spans

THE California Toll Bridge Authority, on December 10 authorized reclassification of tolls on the Carquinez and Antioch bridges. The new rates became effective December 16.

The action of the Authority effected a general reduction in truck tolls of approximately twenty per cent and made the rates uniform for various classes of traffic. The new rates are:

Class	Vehicle	Rate Carquinez	Rate Antioch
1—	Automobiles, ambulances, hearses, taxis	$0.30	$0.30
2—	Trailers drawn by automobiles	.25	.25
3—	Buses	1.00	.75
4—	Motorcycles	.15	.15
5—	Tricars	.20	.20
6—	Commutation—For passenger automobiles only. Book to contain from 50 to 54 one-way trip tickets (depending on length of calendar month), good for the calendar month	10.75	10.75
	In addition the book will contain twenty (20) provisional tickets, each good for a one-way trip upon presentation and payment of twenty-five cents (25¢), provided all regular tickets have been used. Additional provisional tickets for the same calendar month will be issued upon surrender of the complete empty cover—front and back—of a $10.75 commutation book of the same month.		
7—	Trucks and truck trailers, including any load:		
	Gross weight up to 4,000 lbs., per ton at	.30	.275
	Additional gross weight from 4,001 lbs. to 8,000 lbs., per ton, at	.25	.225
	Additional gross weight from 8,001 lbs. to 12,000 lbs., per ton, at	.20	.175
	Additional gross weight from 12,001 lbs. to 16,000 lbs., per ton, at	.15	.125
	Additional gross weight from 16,001 lbs. to 20,000 lbs., per ton, at	.10	.075
	Additional gross weight from 20,001 lbs. to 24,000 lbs., per ton, at	.05	.025
	Additional gross weight over 24,000 lbs., per ton, at	.01	.01
	Minimum charge	.45	.45
8—	Vehicles requiring special permit.		
	Gross weight per ton	$0.30	$0.275
	Minimum charge	1.00	1.00
	Vehicles exceeding limits of special permit or which, through no fault of the Division of Highways, are not provided with a special permit, gross weight per ton	.45	.45
9—	Vehicles not otherwise specified.		
	Gross weight per ton	.30	.275
	Minimum charge	.50	.50

The Authority also extended th lease on the restaurant at the Car quinez bridgehead for a period of on year and gave State Director of Pub lic Works Frank W. Clark authorit to terminate leases held on othe bridge properties. The propertie concerned have to do with fishin wharves on the Carquinez bridg property.

The Authority rejected bids fo the lease of property under the Fift Street approach to the San Francisco Oakland Bay Bridge and authorize the calling of new bids.

Traffic on Bay Bridge Totaled 1,386,660 Vehicles in December

DECEMBER traffic on the San Francisco-Oakland Bay Bridge held up well in spite of many days of bad weather, showing a total of 1,386,660 vehicles. The heaviest day of the month was Christmas when 60,737 vehicles crossed the bridge.

Truck tolls on the Carquinez an Antioch bridges were adjusted an reduced about 20%, effective o December 16.

Traffic for December on the Sa Francisco-Oakland Bay Bridge an the Carquinez Bridge is tabulate below:

	San Francisco-Oakland Bay Br.	Carquinez Bridge	Antioc Bridg
Passenger autos and auto trailers	1,277,709	248,847	11,05
Motorcycles and tricars	2,706	376	
Buses	18,526	4,800	19
Trucks and Truck Trailers	66,874	19,356	1,73
Others	20,845	163	
Total vehicles	1,386,660	273,542	12,99

Future Freeway Construction

(Continued from page 9)

Only a small portion of this mileage has been completed. A small portion is under construction, a portion is in the planning stage and another portion is ear-marked for future construction as funds become available.

Freeways are here to stay. The California Highway Commission is empowered to declare additional freeways and the engineers are prepared to design and construct them. The progress of ultimate future construc tion, however, will depend on publi reaction. If the travelling publi finds freeways to their advantage t such an extent that there is a aroused public demand for such fa cilities and if necessary funds ar provided, the ultimate future of free ways is unlimited.

A railroad agent in Africa had been repr manded repeatedly for doing things withou orders from headquarters and one day h boss received the following telegram:

"Tiger on freight platform eating con ductor. Wire instructions."

City of Martinez Takes Over Benicia-Martinez Ferry

ALL THE LEGAL requirements having been fulfilled, including the execution and acceptance of all necessary documents, Director Frank W. Clark of the Department of Public Works announces that the city of Martinez took over ownership and operation of the Benicia-Martinez ferry at 12 midnight December 31.

"It will be recalled," said Director Clark, "that the agreement to transfer this ferry was made a part of the transaction for the purchase by the State of the Carquinez and Antioch bridges from the American Toll Bridge Company. The ferry franchises and properties were owned by the Martinez-Benicia Ferry and Transportation Co., a subsidiary of the Toll Bridge Company.

"By the terms of that purchase, the disposition of the ferry was placed in the hands of the Department of Public Works and the cities of Benicia and Martinez were designated by me to take over ownership and operation of the ferry.

LEGISLATURE EMPOWERED CITIES

"The cities lacked the legal authority to operate a ferry and a bill was accordingly prepared and introduced at the recent extra session of the legislature and passed and approved by Governor Olson on December 5. It gave the cities necessary power to acquire and operate the ferry. All that remained was the sanction of the Railroad Commission.

"Upon the joint application of the American Toll Bridge Company, the Martinez-Benicia Ferry and Transportation Co., and the cities of Benicia and Martinez, the Commission authorized the transfer of the public utility's property.

"The city of Benicia withdrew and officially expressed approval of the transfer to the city of Martinez. Ownership, operation, and maintenance of the ferry system is now vested in the city of Martinez.

"The properties transferred include the steamers Issaquah and Seattle, real estate in both Benicia and Martinez, docks, buildings, shops and other improvements.

"Personal property transferred includes a pile driver, several fuel tanks, the furniture and fixtures of the Benicia office, shop equipment and other machinery, including a forge and blacksmith equipment.

"The Ferry Company also transferred to the city all its right and title to the franchise to keep and take tolls on a public ferry over Carquinez Straits granted by the Board of Supervisors of Contra Costa County. Under the Toll Bridge Authority Act no further franchises may be granted until after the Carquinez Bridge becomes toll-free. The existing ferry, however, may continue to be accepted as a publicly-owned enterprise."

Two Olympic Boulevard Units Completed in Los Angeles

(Continued from page 12)

miles and 1.05 miles respectively and work on the two contracts was carried on concurrently. Both contracts were partially financed from P. W. A. funds and were let by the City of Los Angeles. Preparation of plans, the securing of the right of way, and the construction inspection were handled by the State Division of Highways.

Work on the first of these contracts, from Beverly Glen to Pontius Street, was started January 2, 1940 and was completed June 12, 1940. Work on the second contract, from Pontius Street to Bundy Drive, was started February 28, 1940 and was completed June 15, 1940.

The two contracts cost $226,667 and $151,059 respectively. Both contracts were awarded to Basich Bros., contractors, who were low bidders on each contract. Inspection was under the supervision of State Resident Engineer E. A. Parker.

Both contracts called for construction of 86 feet between curbs, there being 4 twelve-foot lanes of asphaltic concrete, 2 eleven-foot lanes of portland cement concrete pavement, and 2 eight-foot parking strips of portland cement concrete adjacent to the curbs. Right of way for these two contracts was acquired by the State and the City of Los Angeles at a cost of about $230,000, making a total right of way and construction cost of about $608,000 for the 2.31 mile portion constructed by the State.

BISECTS FOX STUDIO

The highway bisects the grounds of the Twentieth Century-Fox Studio, being somewhat below natural ground elevation. It has been necessary to construct a bridge across the highway in these grounds to preserve contact between studio buildings on opposite sides of the highway.

The total distance along Olympic Boulevard from Flower Street in Los Angeles to Lincoln Boulevard (Coast Highway) in Santa Monica is about 14 miles. Of this distance 10.2 miles are improved to ultimate width and standards under the two State contracts above described and under ten separate city of Los Angeles projects.

Another one-half mile section between Arlington Street and St. Andrews Place is under construction as a city sponsored W. P.A. project.

Two other sections (Hoover Street to Vermont Avenue and Berendo Street to St. Andrews Place) aggregating 1.5 miles in length, are in service but have not yet been widened to conform to the rest of the route. When the present city project from Arlington Street to St. Andrews Place is completed, about twelve miles of the route will be in service from Flower Street in Los Angeles to Bundy Drive in West Los Angeles.

(Continued on page 18)

Tiny Glass Beads Used to Make Traffic Lines Brighter at Night

By MARTIN A. O'BRIEN, Maintenance Assistant

EVER since highway departments have been painting traffic lines, methods have been tried or proposed to increase the visibility or effectiveness of the striping during the hours of darkness. One of our neighboring states is making experiments with luminous paint; an electrical engineer has patented tubes of light for inserting in the traffic line—each method to improve the nighttime visibility of the highway centerline.

In keeping with the policy of providing the best possible service to highway traffic, consistent with existing funds, the Division of Highways has tried out various methods to increase the nighttime visibility of traffic lines. A process now developed consists of placing small glass spheres in the traffic lacquer.

REFLECT LIGHT BEAMS

This method has proved successful in making the striping brighter and more effective at night. The glass spheres or beads reflect the head light beams and return the color of the painted line. The beads are, therefore, effective with either white or yellow traffic lacquer.

There is no sparkle to indicate the presence of glass spheres, but the resultant white or yellow line is brighter at night. This feature is particularly desirable on concrete pavements owing to the low visibility of traffic lines after a short period of wear.

The method of application is quite simple. A bead dispensing machine is placed directly behind and approximately eighteen inches away from the spray nozzle of the paint rig. When in motion, the rubber tired wheels of the machine turn a fluted cylinder in a hopper, which by gravity, feeds the glass spheres onto the wet paint. As the lacquer dries, the beads become embedded and firmly locked into place.

Dispensing machines are available for single 4 inch lines and 9 inch double lines. The capillary attraction of the California lacquer closes over the smaller beads and creeps up the sides of the larger sizes, holding them firmly in place. As the line wears down, some of the larger size spheres become loosened and disappear under the action of traffic. The smaller sizes, however, are then uncovered and function.

The glass spheres or beads are graded as to size. They all pass through a No. 80 mesh and are retained on a 150 mesh screen; the average size is about 1/100 of an inch in diameter. The manufacturer of the beads claims their use in traffic lacquer prolongs the life of the painted lines to approximately double the period experienced without their use.

The rate of application followed the manufacturer's recommendation to use 100 pounds of spheres to one mile of 4 inch line, using fifteen or sixteen gallons of lacquer per mile.

CLEANED BY TRAFFIC

It is not necessary to clean traffic lines when painted with beads. Any small accumulation of road dust collected between the spheres is quickly removed by the action of traffic.

Trial applications have been made, or are proposed, for each highway district. The painting has been limited to curves, no passing zones or where a distinctive traffic line is desirable for night travel.

Approximately one mile of 4 inch line was painted with beads on the Redwood Highway, north of Eureka. This section of highway borders the ocean and is in an area of heavy fog. Approximately 20 miles of the Bayshore Highway, between Redwood City and San Francisco, has been painted with an application of beads.

A section on the Ridge Route in Los Angeles County, one-half mile long, at the crest of a 5 mile grade, was also selected for beads. Oil drippings so obliterated the traffic lines that frequent repainting was necessary. Since the beads were applied, a noticeable increase in night visibility is observed, even though the traffic lines were considerably darkened by oil. At night the light rays are reflected by the beads through the film of oil.

The photographs on the opposite page were taken of a double line painted on U. S. 99 E in Sacramento County during March, 1939, which carries approximately 7000 vehicles per day. The line is easily discernible at night, after approximately twenty months of wear. While the paint has flaked off in some spots, the line is still visible and retains beads where the lacquer remains.

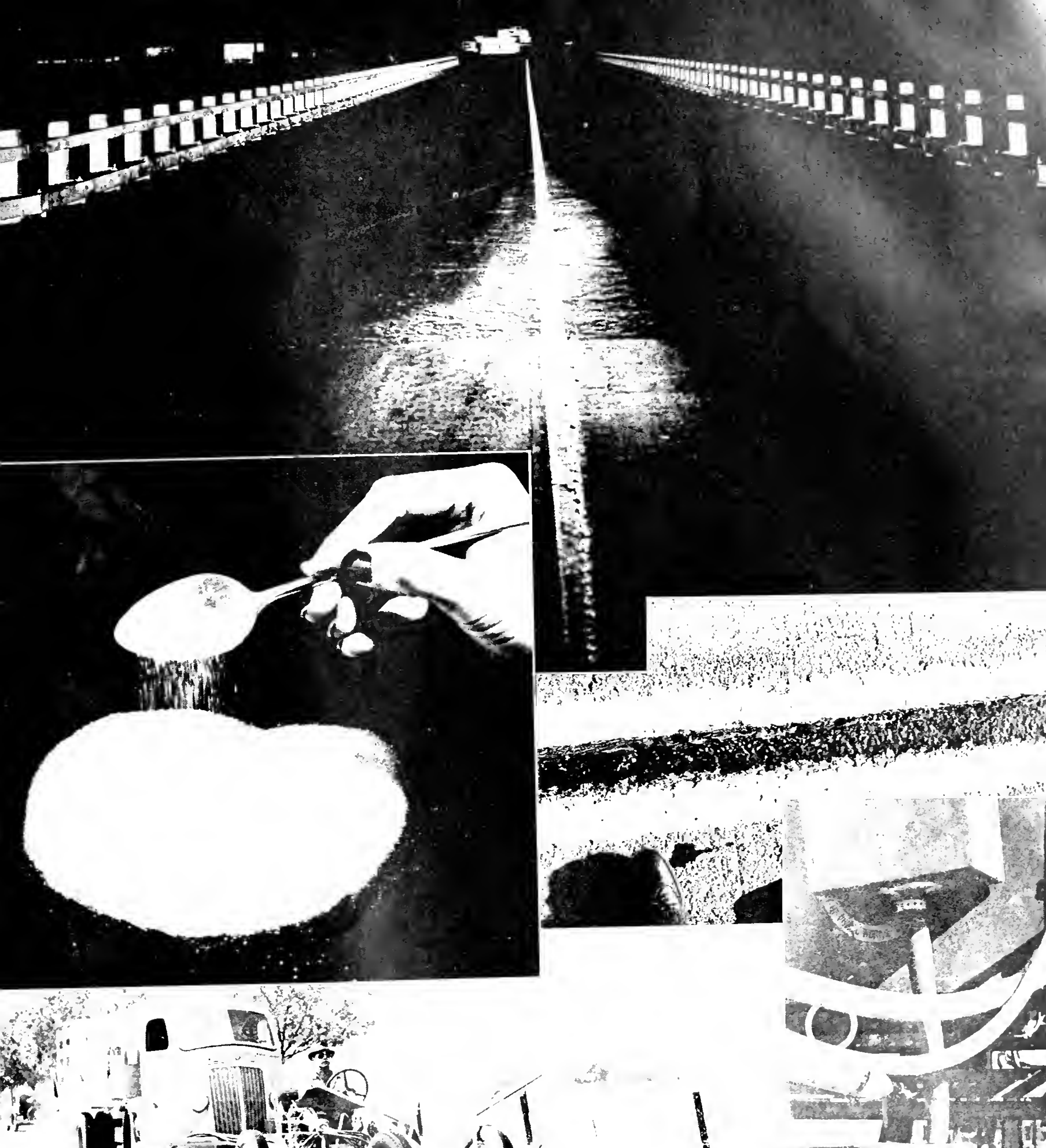
REPAINTING UNNECESSARY

It is not necessary to repaint a line containing the glass spheres or beads until its nighttime visibility reaches a point where it is not effective. An inspection will then disclose that few if any beads remain. Repainting, therefore, will not build up the line with successive layers of beads.

Experiments have been made using glass beads in connection with painting messages on the pavement such as STOP, Pedestrian Crossing, and Railroad Crossing. On the early applications of this type of painting, the beads were applied with a salt shaker. A spray nozzle has now been developed for this purpose.

The use of the glass beads is more or less experimental in California, and our conclusions are based upon observations of a few sample applications. The beads appear to be economically justified on the basis of improved service for selected locations. The cost for labor in painting traffic lines is increased when beads are applied, due to a slowing down of the paint crew with frequent stops to replenish the bead supply.

The high price of the beads, plus added labor, offset the advantage resulting from the prolonged life of the traffic lines. It does not appear desirable, therefore, to make the use of beads a general practice in traffic striping work.



Top photo—Visibility at night of traffic line with beads mixed in lacquer compared with line in foreground painted without them. Left center, beads dropping from spoon are 1/100th of an inch in diameter. Right center—Stripes ragged but bright since 1939. At bottom—striping machine and hopper attachment through which beads are sprayed on the wet paint of stripe

Constructing the Antler Bridge

By CHARLES R. POPPE, Resident Engineer

WORK was started on the Sacramento River crossing at Antler, Shasta County, in March, 1940, and has been progressing at a rapid rate since that time. The structure is now 75% complete.

The Antler Bridge is one of the projects necessitated by the relocation of the Pacific Highway, U. S. 99. Because of the construction of the Shasta Dam, the future flooding of the canyons of the Sacramento, Pit and McCloud Rivers makes it necessary to reconstruct approximately eighteen miles of highway, which is being financed principally by the U. S. Bureau of Reclamation.

State funds are also being used to supplement the Federal funds where improvements in the standards of construction are desired. At the Antler Bridge the State's share is approximately 25%.

STEEL DECK TRUSS TYPE

The Antler Bridge is a steel deck truss bridge 1330 feet in length with concrete piers and abutments. In addition to the two abutments, there are two anchor piers and four main piers. The piers vary in height from 14 feet to 150 feet above ground surface.

The concrete deck will be approximately 210 feet above ground surface at the river. The span lengths are as follows: One at 91.96 feet, one at 188.85 feet, one at 251.82 feet, one at 272.84 feet, one at 251.88 feet, one at 188.93 feet and one at 79.79 feet. The roadway surface will provide a traveled way of 50 feet between curbs with two two-foot-six-inch sidewalks.

Before work on the main piers was started, the contractor made a careful study of several methods of placing the concrete and handling the forms. The method chosen was a crane capable of being moved from pier to pier as necessary. The boom on the crane could be extended as the pier height increased. At the tallest pier, a boom length of 140 feet with a 20-foot jib was required. A one-yard bottom dump bucket was used for handling the concrete. This method proved economical and very satisfactory.

CANTILEVER METHOD USED

Steel erection was started during the month of September, 1940, and is expected to be completed about February 1, 1941. The cantilever method is used in erection with a traveler working form the north end of the bridge to the south. A temporary steel falsework bent is used near the center of each span. In order to erect the 174-foot central suspended span by this method, it was necessary to provide temporary top and bottom chord connections, which will be released when the erection reaches the south anchor pier.

Alignment on the bridge consists of a 5000-foot radius curve compounded to an 850-foot radius curve at the south end of the structure. Pier caps were constructed higher on the west than on the east ends in order to provide for the necessary superelevation required on the roadway. The structure is also on a vertical curve with a +2.5% grade at the south end and a —4.25% grade at the north end.

The steel was fabricated so that the correct vertical curve would be obtained under full dead load. The trusses were fabricated with a horizontal bend at approximately the quarter points of each span in order to provide for the roadway curvature. Due to the horizontal curvature and superelevation, all the diagonal bracing members are of different lengths. No trouble was experienced in the field erection, with all members fitting properly. All main connections were bolted and pinned 100%. Riveting is proceeding as closely as possible behind the erection.

PAINTING RIG DEVISED

The steel is being sandblasted and painted with one coat of paint in the shop. Two field coats will be applied after erection. Field painting at present consists of priming the field rivet heads and such abrasions as can be reached without the use of staging. After the deck is poured and the weather is such as to permit large-scale painting operations, the contractor proposes to construct a rig on the deck with suspended arms. Staging will be supported on these arms in order to provide access to the interior members.

The major contract quantities include the following: 8000 cubic yards structure excavation, 1,270,000 pounds reinforcing steel, 8500 cubic yards reinforced concrete, 468,000 pounds carbon steel, 2,860,000 pounds alloy steel. The cost of the structure is approximately $673,000.

The work is being performed under contract by the United Concrete Pipe Corporation. The Columbia Steel Company is sub-contractor of steel fabrication and erection. It is anticipated that the project will be completed about August, 1941.

Two Olympic Boulevard Units Completed

(Continued from page 15)

This leaves about 2 miles from Bundy Drive to Lincoln Boulevard in Santa Monica which is unimproved. It is expected that this portion of the route will be constructed during the next biennium and that the two present narrow sections will be widened during this same period of time. This will complete the portion of the route from downtown Los Angeles to Santa Monica and will provide an additional thoroughfare similar to Wilshire Boulevard, although on considerably higher standards of alignment.

Funds expended on this route to date for right of way are $2,022,000 —for construction $1,739,000, or a total of $3,761,000.

These funds were provided as follows:

¼¢ Gas tax fund for State Highways within cities	$2,268,000
State Highway funds 1¾¢ gas tax	836,000
Federal Public Works Administration	542,000
Federal Works Progress Administration	71,000
City of Los Angeles	44,000
	$3,761,000

way bridge across Sacramento River at Antler on relocation of U. S. 99 made necessary by construction of Shasta dam. It is a steel deck truss structure 1330 feet long. The concrete deck will be 210 feet above the river

Gov. Olson Dedicates and Opens Arroyo Seco Freeway

(Continued from page 8)

Great care was taken to protect natural sycamores with masonry retaining walls

address of welcome. He was followed by Albert I. Stewart, Vice Chairman of the Board of Directors of the City of Pasadena and by Mayor Fletcher Bowron of the City of Los Angeles.

A narration of the history of the Arroyo Seco dating back to 1769, when Father Juan Crespi, Franciscan padre with the Portola expedition, first came upon the Arroyo, was recited by Balfour.

Short talks were made by Wright L. Felt, representing P.W.A.; Clayton E. Criggs, representing W.P.A.; S. V. Cortelyon, District Highway Engineer of Los Angeles, under whose supervision the parkway was constructed; State Highway Engineer C. H. Purcell, Larry Barrett, Chairman, and L. G. Hitchcock, member, of the California Highway Commission, and Director of Public Works Clark.

Representing the Army on the speakers' stand were Major General Jacob E. Fickel, Commander of the Southwest Air District, Army Air Corps, at March Field; Col. Allen Kimberly, Commander at Fort MacArthur; and Major H. Bunting, representing General E. Calladay, Commander of the anti-aircraft forces in the district embracing Texas, Arizona, New Mexico, California and Nevada.

ARMY PARTICIPATES

"The Army wants good roads," General Fickel said. "Their use would be imperative in times of emergency. This is such a road."

Army participation included a concert on the steps of the Los Angeles city hall prior to the start of the parade by the Third Coast Artillery Band, which headed the caravan, and the raising of the Stars and Stripes at the dedication site by a color guard from this unit. Selections were rendered by the Pasadena Junior College Bulldog Band while the crowd awaited the arrival of the caravan at Fair Oaks Avenue in South Pasadena.

Translated literally, Arroyo Seco means "Dry Wash." For many years before and after the coming of the white man to California, the Arroyo during the rainy season carried flood torrents to the sea. In order to build the parkway, this flood menace had to be controlled, and to this end the Arroyo Seco Flood Control Channel, extending from Devil's Gate Dam in Pasadena to the Los Angeles River in Los Angeles city, a distance of 10.5 miles, was constructed by the W.P.A. at a Federal cost of $7,000,000 plus $880,000 from four sponsors, the State Division of Highways and the cities of Los Angeles, Pasadena and South Pasadena.

WILL CARRY PEAK FLOOD

The channel is now prepared to carry a peak flow in flood times of 13,500,000 gallons of water per minute to the Los Angeles River, a peak capacity twenty times that of the Metropolitan Water District aqueduct. Millions of yards of earth were excavated from the Arroyo Seco in the building of the channel, which is designed to confine the waters of the drainage area in a lined channel along the parkway.

Public spirited citizens and civic organizations played an important part in bringing about the Arroyo Seco Parkway. In addition to our own Division of Highway engineers, tribute for their untiring efforts in making possible the West's first modern freeway should fittingly be paid to City Engineer Harvey Hincks of Pasadena and his assistants for their co-operation and early plans for the parkway in Pasadena and South Pasadena; to Frank Clough, City Engineer of South Pasadena; to City Engineer Lloyd Aldrich of Los Angeles and his deputies, Merrill Butler, L. E. Arnold, C. J. Shults, L. W. Armstrong, C. L. Bell, and R. W. Stewart for preparation of intricate plans in co-operation with State engineers, and for Engineer Aldrich's efforts in securing large Federal allotments for the Arroyo Channel.

FEDERAL GOVERNMENT AID

To Dr. L. I. Hewes and C. H. Sweetser of the U. S. Public Roads Administration; to Wright L. Felt of the P.W.A. and to R. D. Spencer and Bernard Sewell of the W.P.A., representing the Federal government ithout whose aid the parkway never ould have been completed.

To the park superintendents and ommissioners of the three cities for heir aid in beautification and right f way.

To the Santa Fe and Union Pacific ailroads for changing facilities on heir private rights of way to fit in ith the parkway, thus effecting subtantial savings in the parkway contruction.

To the spirit of cooperation evienced by the many contractors and heir employees whose willingness to id enabled the project to advance ell ahead of schedule.

THANKS TO ASSISTANTS

It was my honor to act as chairan of the Arroyo Seco Parkway Dedication Committee, which made rrangements for the ceremonies atendant upon the opening of the arkway and I wish to take this oportunity to express my appreciation f the assistance given to me by the ollowing committee chairmen: Caraan and decorations, Stephen W. unningham, City Councilman, Los ngeles; Publicity, Harrison R. aker, Arroyo Seco Parkway Ass'n. Pasadena; Policing, E. Raymond ato, Chief, California Highway Parol; Dedication ceremonies, Andrew . Porter, Mayor of South Pasadena; Dedication luncheon, Edward S. Graam, Chairman, Arroyo Seco Parkay Ass'n, Pasadena; Finance, T. J. Haddock, President, J. E. Haddock o., Ltd., Pasadena.

No Other Like It

Redding, California

epartment of Public Works,
ublic Works Building,
acramento, California.

ear Sirs:

I'm writing this note to ask you to lease change my mailing address from odi, Calif., to the one as given above.

I certainly enjoy getting your magaine and think that there is no other magazine on the market that gives so much information per page. It certainly s informative as to what is going on in he Division of Highways and the Departent of Public Works.

Thank you for your service in the past. hope that it will continue in the future.

Sincerely yours,

James F. Culbertson

Timid Frosh: "I could sit and look at you orever."

Gal Coed: "That's what I'm starting to hink."

Department History In The Next Issue

The history of the State Department of Public Works together with a comprehensive description of the activities of this largest agency of our State government will be presented in the next issue of this magazine. The work of its three component divisions, namely, the Division of Highways, Division of Water Resources and Division of Architecture touches, very intimately, on numerous occasions during the year, the life and interests of every citizen of California.

The growth of the department from the office of State Engineer with a comparatively few employees in 1878 to its present status with 6,000 employees some of whom are located in every city and county of the State is a striking result of the march of time in California.

Non-Highway Use of Motor Fuel More than 10 per cent

More than 10 per cent of the 23,000,000,000 gallons of motor fuel consumed in the United States in 1939 was not used on the highways but in scores of other gasoline-motor operations, a report of the Public Roads Administration reveals.

This nonhighway use, which includes aviation, agriculture, motor boats, other gasoline engines of all kinds, construction machinery, cleaning and scores of other uses, as well as the unavoidable losses the petroleum industry suffers in normal rational handling, amounted to more than 2,000,000,000 in 1939.

Of the nearly 21,000,000,000 gallons used in motor vehicles on the highways, the report shows, private and commercial motorists consumed 97.4 per cent and public use in vehicles of Federal, State, county and municipal governments 2.6 per cent.

Eliminating 2-Lane Coast Link

(Continued from page 1)

the sand off the bluff to construct a ramp road on a 20 per cent grade to the top. After the road was completed a two yard power shovel was moved to the bench on the bluff and the removal of the sand was then comparatively easy.

While the sand did not give trouble, the drilling and blasting of the volcanic breccia overburden was difficult. Large charges of powder had to be used to shatter the overburden to prevent it overhanging the shovel. The volcanic breccia when finely shattered made excellent subgrade material.

The portion of the contract on the easterly end, including Railroad Slide, provided for grading only. Of the balance of the contract, substantially all of the paving operations are completed, structures built and dividing curb in place. Shoulders, planting, finishing, etc., and the Railroad Slide area remain.

Completion of the work will bring the Roosevelt Highway another step nearer modern standards.

This work is being financed with Federal Aid and is being carried on under the immediate supervision of C. N. Ainley, Resident Engineer, A. N. George, District Construction Engineer, and S. V. Cortelyou, District Engineer.

A. R. B. A. Convention

Roads for Defense [illegible] the 1941 Convention of the American Road Builders' Association. Outstanding [illegible] and representatives of the U. S. War Department will [illegible] in [illegible] New York City, January 27-31.

Courses for Public Employees

Evening [illegible] of [illegible] have been offered by the Civic Center Division of The University of Southern California School of Government [illegible] courses in Prestressed and Reinforced Concrete, Statically Indeterminate Structures, and Sanitation and Purification of Water, as well as [illegible] electrical and mechanical engineering courses.

Detail Of Major Project Allocations Budgeted F

Continuing the article on the budget from page two, the ensuing pages present tabulations showing the al of the State Highway System during the ninety-third and ninety-fourth fiscal years of the biennium beginning Jul lines the amount appears in parentheses for one of the counties, indicating that the two counties share the alloca

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
Alameda	5	Greenville to Livermore (portions)		$187,350	
Alameda	5	Boehmer Hill and East Slope of Castro Hill	1 5±	94,700	
Alameda	5	Dublin to Livermore	18 7	23,070	
Alameda	5	Hayward to Dublin (portions)	1 1	7,280	
Alameda	69	Ashby Avenue to Bay Bridge Distribution Structure	1 7	36,420	
Alameda	69	Oak Street to High Street	3 3	1,578,350	
Alameda	69	Albany Overhead to Ashby Avenue	2 8	85,000	
Alameda	107	Alameda Creek		101,380	
Alameda	107	Arroyo de Laguna		38,850	
Alameda-San Francisco	68	San Francisco-Oakland Bay Bridge (see San Francisco)		1,700,000	$2,152,400
Alpine	23	South of Markleeville		2,430	
Alpine	24	At Woody Gulch		14,570	
Alpine	24	Summit of Pacific Grade to Wolfe Creek Road (portions)		12,100	29,100
Amador-Calaveras	65	Across Mokelumne River		72,850	
Amador	34	Silver Lake to 3 miles east	3 0	12,150	85,000
Butte	3	Biggs Road to Tehama County Line (portions	3 0	25,500	
Butte	21	Feather River to West Branch	10 4	146,300	
Butte	47	Pine Creek Overflows		50,990	
Butte	87	At Brush Creek	0 4	35,450	
Butte	87	At Grass Draw		6,900	
Butte	45	At Big Butte Creek Overflow		10,760	275,900
Calaveras	24	County Line to Valley Springs (portions)	5 0	30,350	
Calaveras	24	Dorrington to Black Springs (portions)	5 8	18,220	
Calaveras	24	Cabbage Patch to Big Meadows	3 0	9,110	
Calaveras	24	Angels Camp to Murphy's (portions)	2 0	18,220	
Calaveras-Amador	65	Across Mokelumne River (see Amador County)		(72,850)	75,900
Contra Costa	14	Richmond to Carquinez Bridge (portions)	4 8	169,950	
Contra Costa	14	Richmond to Martinez (portions)	17 6	17,000	
Contra Costa	106	Franklin Canyon; Martinez to Route 14 (portions)		546,350	
Contra Costa	106	Hercules to Martinez (portions)		19,400	752,700
Del Norte	1	Richardson Creek northerly (portions)	2 65	17,600	
Del Norte	46	Klamath to Klamath Glenn (portions)		18,820	
Del Norte	71	1.5 miles north of Crescent City		15,180	
Del Norte, Humboldt, Mendocino	1	Various safety items		18,200	69,800
El Dorado	11	2¼ miles east of Clarksville to 1¼ miles west of El Dorado (portions)		349,660	
El Dorado	23	At branches of Big Meadow Creek		2,400	
El Dorado	23	Across Upper Truckee River		3,040	
El Dorado	65	¼ mile north of Cool to Lime Kiln Road (portions)	1±	6,300	361,400
Fresno	4	Malaga to Cherry Avenue	3 8	437,000	
Fresno	10	Warthan Canyon; Parkfield Junction easterly (portions)	1 6	85,700	
Fresno	10	Coalinga to Kings County Line (portions)		12,140	
Fresno	41	White Deer Road to Forest Boundary	3 12	48,570	
Fresno	41	Fowler Switch Canal		8,500	
Fresno	41	Kings Slough and Overflows (12 openings)		125,050	
Fresno	76	Big Dry Creek		14,570	
Fresno	76	Humphreys Creek		3,040	
Fresno	76	Home Creek		18,210	
Fresno	76	Snowslide Creek		5,500	
Fresno	76	Corrall Creek		19,500	
Fresno	76	Pitman Creek		7,300	
Fresno	76	Route 125 to Huntington Lake (portions)		24,280	
Fresno	125	Hub Station to Fresno (portions)		12,140	
Fresno-Madera	125	Fresno to 1.6 miles north San Joaquin River; Canal Bridge (see Madera County)	9 3	(489,300)	821,500

nstruction of Highways In 93rd-94th Fiscal Years

f highway funds recommended by the State Highway Commission for each proposed major project improvement The items of proposed expenditure are grouped by counties and in cases where the projects cross county is only included in the county total column opposite the name of the other county.

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
lenn	45	0.7 mile west to 0.5 mile east of Butte City; Sacramento River	1 7	$526,300	
lenn	45	At Campbell Slough		17,000	
lenn	45	Willows to Glenn (portions)	3 0	24,300	$567,600
umboldt	1	Across Eureka Slough	0 6	327,800	
umboldt	1	North Scotia Bridge to Rio Dell	1 4	129,300	
umboldt	1	Weott to 0.6 mile north	0 6	73,450	
umboldt	1	Freshwater Lagoon to 1 mile south Orick	3 3	355,120	
umboldt, Mendocino, Del Norte	1	Various safety items (see Del Norte County)		(18,210)	
umboldt	1	Sinclair's northerly (portions)	1 63	10,620	
umboldt	1	Avenue of Giants (portions)	0 28	1,800	
umboldt	1	South Scotia Branch to Fortuna (portions)	5 90	9,100	
umboldt	1	Loleta to Salmon Creek (portions)	5 90	21,850	
umboldt	1	Big Lagoon northerly (portions)	2 00	12,800	
umboldt	1, 56	At Fernbridge Intersection		8,500	
umboldt	20	Across Mad River	0 5	151,760	
umboldt	20	At Minor Creek and Glendale Creek		12,500	
umboldt	46	At Starrit Mine Flumes		1,600	1,116,200
nperial	12	Mountain Springs to Dixieland (portions)		14,800	
nperial	26	El Centro to Brawley	11 3	295,750	
nperial	26	Trifolium Canal to 2 miles north Sandy Beach Road	11 0	371,600	
nperial	26	Coral Wash to north County line		86,260	
nperial	26	Kane Springs to Trifolium Canal (portions)		1,800	
nperial	26	Calexico to El Centro	10 0	43,130	
nperial	26	Between Calexico and El Centro (portions)		9,860	
nperial	27	Intersection of Main Street with S. P. R.R. in El Centro		369,700	
nperial	27	East Highline Canal to Yuma		12,300	
nperial	187	Niland to north County boundary (portions)		61,600	
nperial	187	Bonds Corners to Holtville (portions)		9,300	
nperial	187	Bonds Corners to Holtville (portions)		3,700	
nperial	198	At San Felipe Creek		7,400	
nperial	201	North of Calexico to East of Brawley (portions)		3,700	
nperial	201	Brawley to Calipatria (portions)		12,300	
nperial	202	Seeley to Bonds Corners (portions)		12,300	
nperial	202	East Highline Canal Line Changes	0 6	18,500	1,334,000
yo	23	Cottonwood Creek to Bartlett (portions)	2 5	85,500	
yo	23	At Railroad Crossing Station 528 to Station 533, Section H	0 1	1,200	
yo	23	South of Route 127 to Alabama Gate (portions)	1 5	6,630	
yo	23	Independence to Fish Springs School (portions)	6 0	16,200	
yo	23	Haiwee to Cottonwood Creek and Round Valley Road to Mono County Line (portions)	1 0	3,750	
yo	23	Drainage correction on Primary Routes		3,100	
yo	63	Near Deep Springs School	0 1	300	
yo	76	Laws Junction to Mono County Line	4 6	44,120	
yo	76	Near Plant No. 3	0 05	3,400	
yo	127	Near Shoshone	0 1	1,030	
yo	127	15 miles west of Death Valley to Death Valley (portions)	3 2	1,750	
yo		Various drainage correction on Secondary Roads		620	167,600
ern	4	Fort Tejon to 1.4 mile north of Grapevine Station; Grapevine Creek Bridge	5 9	419,000	
ern	4	Southern Pacific Railroad Overpass to Shafter Road; Lerdo Canal Bridge	7 5	529,150	
ern	4	Famoso to Delano (portions)		49,300	
ern	4	Safety Items on Primary Roads		3,080	
ern	23	1.8 mile south to 1.1 mile south of Junction Route 57	0 7	39,500	
ern	23	Mojave to Red Rock Canyon (portions)	14 5	179,700	
ern	23	Cinco to Ricardo (portions)	1 3	3,700	
ern	58	Mojave easterly (portions)	8 0	17,800	

DETAIL OF MAJOR PROJECT ALLOCATIONS BUDGETED FO

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
Kern	58	Marcel easterly; 5 unnamed creeks		$450,000	
Kern	58	5.6, 5.7, 5.9 miles east of Buttonwillow, Equalizers		20,300	
Kern	58	Main Drainage Canal		11,000	
Kern	58	Buena Vista Slough		44,980	
Kern	58	McKittrick to Rosedale (portions)		18,500	
Kern-Tulare	129	Deepwell Ranch to 1/4 mile north of county line (see Tulare County	8 0	(215,650)	
Kern	138	McKittrick to Kings County Line (portions)		36,900	
Kern	140	Hill Creek Cattlepass		4,200	
Kern	142	Southern Pacific Railroad Tracks to Stine Canal	0 66	73,900	
Kern	142	Barren Creek Bridge		8,950	
Kern	142	Poso Creek Bridge		2,500	
Kern		Various Drainage correction on Secondary Roads		6,160	
Kern		Various Safety Items on Secondary Roads		3,080	$1,921,700
Kings	125	5th Standard Parallel to Stratford; Kings River Bridge	4 7	238,000	
Kings	125	Prairie Draws		970	
Kings	134	Corcoran to Tulare County Line (portions)		6,000	
Kings	138	North and south of Junction of Route 125	10 0	54,630	299,600
Lake	15	Laurel Dell Lake to Tule Lake (portions)	1 75	10,300	
Lake	15	Lucerne Northerly		9,700	
Lake, Mendocino	16	Lakeport to Route 1 (portions)		386,700	
Lake	49	Middletown southerly (portions)	3 9	23,000	
Lake	49	Putah Creek to Lower Lake (portions)		93,500	
Lake	89	Lakeport easterly (portions)	0 8	4,700	
Lake	89	Lakeport easterly (portions)	0 8	4,700	
Lake	89	Intersection with Route 16 southerly (portions)	0 9	5,300	
Lake	89	At Kelsey Creek	0 3	140,800	
Lake	89	At Scott Creek	0 3	62,500	
Lake	89	At Middle Creek		28,500	765,000
Lassen	28	Big Valley Mountain	2 5	10,930	
Lassen	29	Susan Route to Susanville (portions	7 4	6,100	
Lassen, Sierra	29	Constantia to Nevada State Line (portions)		72,850	
Lassen	29	Ravendale to Termo	5 0	20,640	
Lassen	73	Brockmans to Madeline (portions)	3 5	10,930	
Lassen	73	Viewland to Secret Valley (portions	10 0	30,350	151,800
Los Angeles	2	Ventura Boulevard (portions)	3 1	221,800	
Los Angeles	4	Castaic to Alamos Creek (portions)	16 0	49,300	
Los Angeles	9	Glendora to La Verne (portions)	4 5	14,800	
Los Angeles	26	Right of Way, Ramona Freeway; Los Angeles to Pomona (portions)		406,700	
Los Angeles	26	Garey Avenue to Hamilton Boulevard in Pomona	0 7	43,130	
Los Angeles	26	Valley Boulevard Intersection		3,080	
Los Angeles	60	Latigo Canyon to Winter Canyon	3 5	492,920	
Los Angeles	60	South City Limits to 24th Street in Hermosa Beach	1 2	91,190	
Los Angeles	61	Angelus Crest Highway		591,500	
Los Angeles	156	0.5 mile south of Topanga Post Office		3,080	
Los Angeles	158	Sepulveda Boulevard; Centinella to Jefferson	0 7	88,720	
Los Angeles	158	Sepulveda Boulevard; south of Waterford to Ohio Avenue	0 83	166,360	
Los Angeles	158	Through Sawtelle Military Home	1 0	17,250	
Los Angeles	162	Santa Monica Boulevard, Fairfax to Croft	0 7	49,300	
Los Angeles	164	La Tijera to Sepulveda	1 5	7,400	
Los Angeles	166	Santa Ana Freeway (portions)		985,840	
Los Angeles	168	Rosemead Boulevard, Route 60 to Center Street	3 4	271,100	
Los Angeles	168	Rosemead Boulevard, Siphon Road to Garvey Avenue	2 6	154,040	
Los Angeles	168	Rosemead Boulevard, Glendon Way to Valley Boulevard	0 5	67,780	
Los Angeles	168	Rosemead Boulevard, Las Tunas Boulevard to Longden Avenue	0 7	92,420	
Los Angeles	169	Bellflower Boulevard, Artesia Street to 800 ft. south of South Street		86,260	
Los Angeles	170	Orange County Line to 1 mile north		1,230	
Los Angeles	173	Olympic Boulevard, Centinella to Lincoln in Santa Monica	2 3	542,210	
Los Angeles	174	Downey Avenue to Orange County Line (portions)		24,650	
Los Angeles	179	Route 60 to San Gabriel River	1 4	12,320	
Los Angeles		Various Allocated to cooperative projects in City of Los Angeles (as detailed hereafter):			6,121,820
Los Angeles	2	Cahuenga Pass; 900 ft. north of Barham Boulevard to 1000 ft. north of Lankershim Boulevard *486,000			
Los Angeles	2	Alameda Street to Vermont (portions) *2,500,000			
Los Angeles	2	Aliso Street to Soto Street (portions) *393,200			

NSTRUCTION OF HIGHWAYS IN 93rd-94th FISCAL YEARS

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
os Angeles	4	Daley Street; Main Street to Pasadena Avenue		*330,000	
os Angeles	4	San Fernando Road; Ensign to Burbank		*35,600	
os Angeles	4	San Fernando Road; Bransford to Truesdale		*47,200	
os Angeles	4	San Fernando Road; Delay to Verdugo Road		*62,000	
os Angeles	26	Ramona Freeway; Aliso Street to City Limits		*500,000	
os Angeles	60	North of Santa Monica		*50,000	
os Angeles	158	Sepulveda Boulevard, Sunset Avenue to south of Waterford and Ohio Avenue to Pico Place		*241,000	
os Angeles	161	Colorado Street, Townsend Avenue to Eagle Rock Boulevard		*92,800	
os Angeles	161	Moorpark Street Bridge and Approaches, Tujunga Wash		*50,000	
os Angeles	163	Bicknell Street to Windward Avenue (portions)		*300,000	
os Angeles	165	Figueroa Street, Neola to Buena Vista Terrace		*112,500	
os Angeles	165-205	Arroyo Seco Parkway and Figueroa Street, Avenue 22 to Figueroa Terrace		*1,300,000	
os Angeles	173	Olympic Boulevard, Berendo Street, to Western Avenue		*310,000	
os Angeles	173	Olympic Boulevard, Hoover Street to Menlo Avenue		*111,000	
os Angeles	173	Olympic Boulevard, Bundy Drive to Centinella Avenue		*46,500	
		* Total cost including cooperative funds; Cooperative Project, City of Los Angeles, 1/4c State Highway Fund			$10,606,200
Iadera	4	1½ mile north of Ash Slough to north County Boundary	1 8	$72,850	
Iadera	4	San Joaquin River to Madera	7 5	30,350	
Iadera	32	Califa to Merced County Line (portions)		36,420	
Iadera, Fresno	125	Fresno to 1.6 miles north of San Joaquin River Bridge; Canal Bridge	9 3	489,300	
Iadera	126	Madera to 3 miles east	3 0	104,780	733,700
Iarin	1	Ignacio to north County Boundary (portions) Novato Creek		437,080	
Iarin	56	At Tomales Bay		4,820	441,900
Iariposa	65	At Maxwell Creek		3,040	
Iariposa	65	At C.C.C. Camp	0 5	7,860	10,900
Iendocino	1	At South Fork Eel River		18,210	
Iendocino	1	¾ mile north of Red Mountain Creek to Piercy	3 6	242,800	
Iendocino	1	Hopland to Crawford Ranch; McNab Creek	6 5	412,800	
Iendocino	1	Northwestern Pacific Railroad to Willits (portions)	1 4	132,940	
Iendocino	1	Elk Creek		3,640	
Iendocino	1	0.5 mile south of Hopland		6,070	
Iendocino, Humboldt, Del Norte	1	Various Safety Items (see Del Norte County)		18,200	
Iendocino	1	Ridgewood Hill (portions)	0 92	5,400	
Iendocino	1	Sherwood Road to Rattlesnake Summit (portions)	2 85	17,790	
Iendocino	1	Rosswarnes northerly (portions)	0 66	3,900	
Iendocino	15	Calpella to County Line (portions)	1 90	11,170	
Iendocino	48	Flynn Creek to Navarro	2 3	78,310	
Iendocino	48	Ward Creek—Mile 45.1		1,200	
Iendocino	48	Fairbanks Hill (portions)	1 22	7,830	
Iendocino	56	At Albion River	0.7	327,800	
Iendocino	56	Mile 2.5 northerly		610	
Iendocino	56	Salmon Creek Bridge northerly		5,220	
Iendocino	56	Mile 5.1 Dark Gulch		12,630	
Iendocino	56	Mile 6.6 south of Buckhorn Creek		9,230	
Iendocino	56	At south City Limits Mendocino City		850	
Iendocino	56	Gualala to Point Arena	3 7	19,300	1,317,700
Ierced	4	Southerly Boundary to 2.6 miles northerly	2 6	97,130	
Ierced	18	East of Merced	0 5	7,300	
Ierced	32	West County Boundary to Foot of Grade and San Luis Creek Line Change	4±	163,900	
Ierced	32	Pacheco Pass to Junction Route 121 (portions)	1 5	18,220	
Ierced	41	Dos Palos Wye to Dos Palos (portions)	4 0	24,280	
Ierced	41	Centinella to Los Banos (portions)	10 8	30,350	
Ierced, Stanislaus	41	Vernalis to Junction Route 32 (portions) (see Stanislaus County)	5 0	30,350	
Ierced	122	West of Merced (portions)	4 0	12,140	
Ierced	123	End of concrete to Merced River (portions)	3 5	24,280	377,600

DETAIL OF MAJOR PROJECT ALLOCATIONS BUDGETED FO

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
Modoc	28	Pit River to Canby (portions)	6 0	$6,100	
Modoc	28	Lakeview Junction to Toms Creek (portions	8 2	14,570	
Modoc	28	Toms Creek to Cedarville (portions)	10 0	12,140	
Modoc	73	Likely northerly	1 0	13,350	
Modoc	73	At New Pine Creek		3,900	
Modoc	73	At Tom Creek, Joseph Creek, and Dry Gulch		16,390	
Modoc	73	Likely to Alturas (portions)	18 6	72,850	$139,300
Mono	13	Vicinity Mile 6.0, Section A	1 5	6,160	
Mono	23	Rock Creek to Casa Diablo (portions)	8 0	98,580	
Mono	23	1 mile north of Bridgeport to Dresslers Corner	1 2	18,480	
Mono	23	Vicinity Mile 12.55 and Mile 14.55, Section J	2 0	22,180	
Mono	23	Station 381, Section J	0 1	920	
Mono	23	Station 116, Section I	0 1	2,160	
Mono	23	Station 543+50 to Station 547+00, Section K	0 1	3,460	
Mono	23	Station 610, Section I		250	
Mono	23	In Leevining		870	
Mono	23	Vicinity Chris' Flat	0 1	4,300	
Mono	23	At Tioga Lodge		12,320	
Mono	23	Casa Diablo Hot Springs to Crestview (portions)	2 7	17,250	
Mono	23	Conway Summit to Bridgeport (portions)	6 0	17,530	
Mono	23	Hot Creek northerly (portions)	8 5	11,460	
Mono	23	Crestview to June Lake Junction	9 7	22,800	
Mono	23	Near Point Ranch		620	
Mono	40	West Boundary to Route 23 (portions)		30,200	
Mono	40	Route 23 to Sand Pit Road	1 5	6,160	
Mono	40	Route 23 to Gas Pipe Springs (portions)	14 3	9,610	
Mono	76	Near Hammil Station	1 0	7,390	
Mono	95	Near Winemuller's, Mile 8.5, Section A	0 4	7,750	
Mono	95	Antelope Valley to State Line (portions)	2 0	5,180	
Mono	111	Grant Lake to Route 23	2 6	37,340	
Mono	111	Station 76 to Station 111+25, Section A	0 6	24,430	367,400
Monterey	2	Salinas to Santa Rita	3 1	361,800	
Monterey	2	Salinas to 2 miles south of Salinas	1 8	152,980	
Monterey	2	At Branstetter Gulch	0 4	38,850	
Monterey	2	At Monroe Gulch	0 3	21,000	
Monterey	2	2 miles south of King City	0 3	28,290	
Monterey	2	King City to Soledad (portions)		26,710	
Monterey, San Benito	2	Santa Rita Mesa to Chittenden Road (portions) (see San Benito County)		(424,900)	
Monterey	2	Bradley to San Ardo (portions)		3,640	
Monterey	2	San Lucas to King City (portions)		18,210	
Monterey	56	Seaside to Castroville		66,780	
Monterey	56	At Salmon Creek		12,140	
Monterey	56	Near Seaside		3,160	
Monterey	56	At Villa, Alder, Willow, Kirk and Lime Creeks and Hot Springs Canyon		12,140	745,700
Napa, Solano	7	Junction of Route 208 to 2½ miles easterly (portion)	2 5	145,690	
Napa	74	Kelly Curves line change		9,710	
Napa, Sonoma	80	Ignacio to Napa (portions)		37,000	192,400
Nevada	17	1.5 miles north Rattlesnake Creek to Grass Valley	4 2	220,950	
Nevada, Yuba	25	Nevada City to Sierra County Line (portions) (see Yuba County)		(123,800)	
Nevada	37	Donner Summit to Donner Lake	2 2	57,650	
Nevada, Sierra	38	1 mile north Farad to 0.7 mile south State Line (see Sierra County)	3 0	(152,370)	278,600
Orange	2	Right of Way; Santa Ana Freeway (portions)		246,460	
Orange	2	Fullerton to Los Angeles County Line (portions)	0 55	5,180	
Orange	43	Santa Ana Canyon Road, Peralto to Olive Cutoff	4 5	295,750	
Orange	43	Santa Ana Canyon Road, through Orange	1 4	24,650	
Orange	43	Santa Ana Canyon Road, Orange to 1st Street, Santa Ana		50,520	
Orange	170	Katella Avenue to Cerritos Avenue		1,110	
Orange	174	Right of way; Santa Ana Freeway (portions)		123,230	
Orange	175	Santa Ana River Bridge		30,800	
Orange	176	Route 62 to Route 2 (portions		3,700	
Orange	182	Orange to Orange County Park (portions)		860	
Orange	183	At Springdale Ditch		7,390	
Orange	184	Newport Boulevard to Santa Ana	1 3	17,750	
Orange	185	1.2 miles south of Route 2 to Route 2	1 2	4,500	811,900

NSTRUCTION OF HIGHWAYS IN 93rd-94th FISCAL YEARS

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
acer	3	Lincoln to Yuba County Line (portions)	2 0	$17,000	
acer	37	2d crossing Nevada County Line to 3d crossing Nevada County Line (portions)	1 0	12,140	
acer	37	Gold Run to Nevada County Line (portions)	2 0	19,420	
acer	38	El Dorado County Line to Nevada County Line (portions)		12,140	$60,700
ımas	21	North Fork to Keddie	21 0	194,300	
ımas	21	Near Quincy		610	
ımas	21	Beckwourth to Edes Ranch	9 3	63,130	
ımas	21	La Porte Road to Western Pacific Subway	4 1	139,620	
ımas	21	Feather River Inn to Beckwourth (portions)	16 0	6,070	
ımas	21	Spring Garden to Feather River Inn (portions)	10 0	6,070	
ımas	21	Spring Garden to Feather River Inn (portions)	12 0	12,140	
ımas	29	Lost Creek to Route 83	3 0	7,280	
ımas	83	Greenville to Crescent Mills	4 1	24,280	453,500
verside	19	1 mile east Mira Loma to 3 miles west of Riverside	4 3	523,730	
verside	43	Riverside to north county boundary	1 3	96,100	
verside	64	4 miles west of Blythe to 3 miles west of Blythe	1 1	62,850	
verside	64	Route 26 to Black Butte		308,080	
verside	64	Indio to junction Route 64-B (portions)		18,480	
verside	64	Perris easterly and Hemet easterly		7,640	
verside	77	Murietta southerly (portions)		5,240	
verside	78	Perris northerly		3,080	
verside	78	Elsinore northerly (portions)		860	
verside	146	Ripley to junction Route 64 (portions)		9,860	
verside	146	Route 64 to north county line (portions)		12,320	
verside	187	Between Coachella and Mecca (portions)		4,930	
verside-San Bernardino	193	Corona to Route 19 (portions) (see San Bernardino County)	5±	(49,300)	
verside	194	San Jacinto northerly (portions)		1,730	1,054,900
cramento	3	American River Bridge to North Sacramento	0 7	847,440	
cramento	4	Cosumnes River and Overflows		32,800	
cramento	4	San Joaquin County Line to Sacramento (portions)		13,360	
cramento	11	Sacramento River Bridge at Isleton		31,570	
cramento	11	Antioch Bridge to 1 mile east	1 0	60,700	
cramento	11	At 3 Mile Slough		19,430	1,005,300
n Benito, Monterey	2	Santa Rita Mesa to Chittenden Road (portions)		424,900	
n Benito	67	Pajaro River Bridge		5,200	
n Benito	119	Cottage Corners to 2 miles north	1 9	119,600	
n Benito	119	At Oat Creek and near Stump Creek		9,100	558,800
n Bernardino	9	Cherry Avenue to San Bernardino	9 4	165,130	
n Bernardino	9	Foothill Boulevard at Station 247, Section A	0 1	2,710	
n Bernardino	19	Through Ontario	2 7	158,040	
n Bernardino	26	Redlands to 3.1 miles east	3 6	44,360	
n Bernardino	26	3.1 miles east of Redlands to Calimesa	2 0	110,910	
n Bernardino	26	State Street to 0.4 mile south of City Reservoir in Redlands	1 7	141,710	
n Bernardino	26	Mission Storm Drain		8,010	
n Bernardino	26	Intersections Monte Vista Avenue and Vernon Street		2,460	
n Bernardino	31	Cajon Pass at Blue Cut Slide, Mile 5.1, Section B		1,480	
n Bernardino	31	Cajon Pass near Keenbrook, Mile 4.0, Section B		980	
n Bernardino	31	Cajon Boulevard at Cable Creek Overflow, Mile 2.5, Section A		740	
n Bernardino	31	Drainage correction; Victorville to Barstow (portions)		2,460	
n Bernardino	43	Victorville to 1 mile east	1 0	79,110	
n Bernardino	43	Near Arrowbear Park		500	
n Bernardino	43	San Bernardino to Route 189 (portions)		8,500	
n Bernardino	43	Running Springs Park to Big Bear Dam (portions)		3,080	
n Bernardino	58	Needles southerly		11,460	
n Bernardino	59	Deer Lodge Park to Mojave Desert	5±	3,080	
n Bernardino	59	At Sheep Creek		620	
n Bernardino	59	Cedar Glen Road to Route 43 (portions)		620	
n Bernardino	189	Squirrel Inn to Lake Arrowhead (portions)		6,160	
n Bernardino	189	Route 43 to Route 59 (portions)		1,230	
n Bernardino	190	Igo to Camp Angelus (portions)		12,300	
n Bernardino	190	San Bernardino to Forest boundary (portions)		16,880	
n Bernardino	191	At north city limits of San Bernardino		1,480	

DETAIL OF MAJOR PROJECT ALLOCATIONS BUDGETED FO

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
San Bernardino	192	Route 77 to Ontario	5 85	$36,970	
San Bernardino, Riverside	193	Corona to Route 19 (portions)	5±	49,300	
San Bernardino	207	Junction Route 43		620	$870,900
San Diego	2	Torrey Pines Mesa to Del Mar Overhead	3 3	142,950	
San Diego	2	Bean Street to Barnett Avenue in San Diego	0 9	221,850	
San Diego	2	Wisconsin Street to 8th Street in Oceanside	1 0	36,970	
San Diego	2	San Ysidro to Chula Vista (portions)		7,400	
San Diego	2	Oceanside to Las Flores (portions)		1,850	
San Diego	12	Pine Valley to Casbere Ranch (portions)		9,860	
San Diego	12	Casbere Ranch to Tecate Divide (portions)		3,080	
San Diego	77	Ash Street, San Diego, to ½ mile north of city limits	7 2	739,380	
San Diego	77	Escondido to San Luis Rey River (portions)		661,130	
San Diego	77	Between Vista and Bonsall		12,320	
San Diego	77	At San Luis Rey River		14,790	
San Diego	77	Vista to north county line (portions)		9,250	
San Diego	78	At Canada Verde		6,780	
San Diego	78	At Descanso Creek Bridge		8,630	
San Diego	78	At Coleman Creek		2,470	
San Diego	78	At Acorn Creek Bridge		9,240	
San Diego	78	At Matagual Valley Creek		18,490	
San Diego	78	Cuyamaca to Julian (portions)		9,860	
San Diego	195	At West and East Channels of Live Oak Creek		14,800	
San Diego	195	At Fry Creek		2,460	
San Diego	195	Pump House line change		9,860	
San Diego	195	Bonsall to Pala (portions)		3,080	
San Diego	195	At bridge west of Pala		4,930	
San Diego	195	Oceanside to junction Route 77 (portions)		7,390	
San Diego	196	Carlsbad to Vista (portions)		3,080	
San Diego	198	San Vicente line change		86,260	
San Diego	198	At Sycamore Creek		4,930	
San Diego	198	At Rust Creek Bridge		1,490	
San Diego	198	At Wright Street Creek in El Cajon		18,480	
San Diego	198	Julian to Scissors Crossing (portions)		6,160	
San Diego	198	Ramona to Santa Ysabel (portions)		6,160	
San Diego	198	El Cajon to San Vicente Creek (portions)		6,160	
San Diego	198	Scissors Crossing to Borego Road (portions)		3,700	
San Diego	198	Scissors Crossing to east county line (portions)		3,700	
San Diego	200	San Diego to Engineer's Springs (portions)		18,490	
San Diego		At Borego State Park		1,850	
San Diego		At Cuyamaca State Park		620	2,119,900
San Francisco, Alameda	68	Administration, maintenance, operation and insurance on San Francisco-Oakland Bay Bridge		1,700,000	1,700,000
San Joaquin	4	At Jahant Corner		3,040	
San Joaquin	53	Lodi Lake to railroad crossing	1 0	3,640	
San Joaquin	75	At Morman Slough		6,070	
San Joaquin	75	At Lone Oak Creek		15,780	
San Joaquin	75	At Hunter Creek		1,460	
San Joaquin	75	At Old and Middle Rivers		24,290	
San Joaquin	97	At Calaveras River		1,220	55,500
San Luis Obispo	2	Line change north of motel	0 4	45,600	
San Luis Obispo	2	San Luis Obispo to Santa Margarita (portions)		6,900	
San Luis Obispo	33	At Santa Rosa Creek Bridge		6,160	
San Luis Obispo	33	Paso Robles to Estrella River (portions)		30,800	
San Luis Obispo	56	San Carpojo Creek to northerly county boundary	3 7	9,830	
San Luis Obispo	56	At Arroyo Grande		24,640	
San Luis Obispo	56	Guadalupe to Oceano (portions)		5,920	
San Luis Obispo-Santa Barbara	57	Remove seven bridges		34,500	
San Luis Obispo	57	Route 2 to Cuyama River (portions)		12,320	
San Luis Obispo	58	At Trout Creek		32,040	
San Luis Obispo	125	Salinas River Bridge		6,160	
San Luis Obispo	147	Arroyo Grande to San Luis Obispo (portions)		4,930	219,800
San Mateo	2	South county boundary to Charter Street in Redwood City	3 22	922,720	
San Mateo-Santa Cruz	56	Santa Cruz to Tunitas (portions) cooperative project with Joint Highway District 9 (see Santa Cruz County)		(157,830)	

NSTRUCTION OF HIGHWAYS IN 93rd-94th FISCAL YEARS

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
n Mateo	56	Tunitas to Half Moon Bay (portions)		$12,100	
n Mateo	68	Redwood City to San Mateo (portions)		7,280	
n Mateo	68	Peninsular Avenue Burlingame to South San Francisco Underpass	6 64	3,520,900	$4,463,000
nta Barbara	2	Hollister Wye to Goleta Airport	4 4	524,960	
nta Barbara	2	0.4 mile east of Las Varas Creek to El Capitan Creek	3 2	359,830	
nta Barbara	2	Olive Mill Road to east city limits Santa Barbara	0 7	33,300	
nta Barbara	2	Right of way; Rancheria Street from Guiteriez Street to north city limits; Bath Street to Milpas Street		492,920	
nta Barbara	2	Right of way; Crescent Drive to Hollister Wye	2 0	12,320	
nta Barbara	2	Zaca to Los Alamos (portions)		2,960	
nta Barbara	2	Alcatraz to Las Cruces (portions)		6,780	
nta Barbara	2	El Capitan Creek to Alcatraz (portions)		4,930	
nta Barbara	2	Junction Route 80 to Stoney Creek (portions)		3,450	
nta Barbara	2	Gaviota Pass to Buellton		1,730	
nta Barbara	56	Orcutt to Guadalupe (portions)		4,930	
nta Barbara	56	Las Cruces to Lompoc (portions)		27,110	
nta Barbara	57	At Wasioja Creek Bridge		6,160	
nta Barbara-San Luis Obispo	57	Remove seven bridges (see San Luis Obispo County)		(34,500)	
nta Barbara	57	At Cottonwood Creek Bridge		6,160	
nta Barbara	80	At San Jose Creek Bridge		1,230	
nta Barbara	149	At Alamo Pintado Bridge		4,930	
nta Barbara	149	Surf to Lompoc (portions)		17,000	1,510,700
nta Clara	5	Bascome Avenue to Park Avenue (Cooperative Project)	1 2	157,850	
nta Clara	32	San Felipe to Bells Station (portions)		12,150	170,000
nta Cruz	32-56	Watsonville to Rob Roy	7 74	461,360	
nta Cruz	42	Sempervirens Creek		14,600	
nta Cruz-San Mateo	56	Santa Cruz to Tunitas (portions) Cooperative Project with Joint Highway District 9		157,830	
nta Cruz	116	San Lorenzo River	0 4±	44,310	678,100
hasta	3	North of Anderson to Redding Subway	7 5	236,750	
hasta	3	Redding to 2½ miles north	2.5	60,700	
hasta	3	La Moine to Siskiyou County Line (portions)	18 5	6,050	
hasta	20	Near Schilling to Shasta	4±	319,310	
hasta	28	In Burney Valley (portions)		3,040	
hasta	209	Summit City to Route 3	2 9	4,860	630,710
erra	25	At Goodyear Creek	0 3	45,530	
erra-Lassen	29	Constantia to Nevada State Line (portions) (see Lassen County)		(72,850)	
erra-Nevada	38	One mile north Farad to 0.7 mile south State Line	3 0	152,370	197,900
skiyou	3	North Approach in Dunsmuir	1.5	84,990	
skiyou	3	Siskiyou County Line to Dunsmuir	1 5	1,820	
skiyou	3	Gazelle to Yreka (portions)	17 0	9,100	
skiyou	46	Across Salmon River		78,300	
skiyou	46	At Irving, Stanshaw and Sandy Bar Creeks		32,780	
skiyou	46	2.5 miles west of Walker Bridge to Hamburg	13 0	97,100	
skiyou	72	Edgewood Road to 2½ miles north	2 5	84,990	
skiyou	72	Near Macdoel to Dorris (portions)	10 0	10,930	
skiyou	72	Four miles north of Weed to Grass Lake (portions)	19 0	10,930	
skiyou	82	Fort Jones to Route 3 (portions)	16 0	6,070	
skiyou	82	Yreka to McCloud (portions)	6 0	3,640	
skiyou	83	Route 3 to McCloud (portions)	9 0	3,640	424,290
olano	7	North of Vacaville to 2 miles north of Power Station	6 0	495,350	
olano-Yolo	7, 6	1.3 miles north of Dixon to 1 mile east of Davis	7 5	382,440	
olano-Napa	7	Junction Route 208 to 2½ miles easterly (portions) (see Napa County)	2 5	(145,690)	
olano	7	Fairfield to 1 mile north of Vacaville (portions)	5 1	30,350	
olano	53	Suisun to Denverton (portions)	4 0	24,300	
olano	90	Route 7 near Richfield Station to 1½ miles north Sweeney Creek		224,610	
olano	208	At Napa River Bridge		97,150	
olano-Sonoma	208	Instalment payment and interest Sears Point Toll Road		36,400	1,290,600

DETAIL OF MAJOR PROJECT ALLOCATIONS BUDGETED FOR CONSTRUCTION OF HIGHWAYS IN 93rd-94th FISCAL YEARS

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
Sonoma	1	Sebastopol Avenue to 9th Street in Santa Rosa; Viaduct		$868,080	
Sonoma-Napa	8	Ignacio to Napa (portions) (see Napa County)		37,030	
Sonoma	8	Sonoma County Line to Napa (portions)		4,370	
Sonoma	51	Beltane to Sonoma (portions)		14,600	
Sonoma	56	Timber Cove Tunnel		4,860	
Sonoma	104	Jenner to Guerneville (portions)		19,430	
Sonoma	208	Junction Route 8 to Solano County Line	2 2	19,430	
Sonoma-Solano	208	Installment payment and interest Sears Point Toll Road (see Solano County)		(36,400)	$967,800
Stanislaus-Merced	41	Vernalis to Junction Route 32 (portions)	5 0	30,350	
Stanislaus	109	Modesto to Junction Route 13	4 0	60,750	91,100
Sutter-Yuba	3	Feather River Bridge Foundations		424,950	
Sutter	15	Sacramento River Bridge at Meridian		34,000	
Sutter	15	Meridian Overhead		2,450	
Sutter	87	One mile to $2\frac{3}{4}$ miles north of Knights Landing	1 8	34,600	496,000
Tehama	3	Cone Lane to Red Bluff	3 [illegible]	48,560	
Tehama	7	South Boundary to Proberta	19 5	24,280	
Tehama	29	Paynes Creek to Lost Creek (portions)	3 0	7,260	80,100
Trinity	20	Prairie Creek to Valdor (portions)	15 0	24,280	
Trinity	20	Tom Long Gulch to east boundary (portions)	10 7	6,070	
Trinity	20	Douglas City to Vitzhums (portions)	1 0	4,850	
Trinity	29	At Hayfork Creek		18,200	53,400
Tulare	4	Goshen Subway to Kings River (portions)		55,450	
Tulare	4	Quail to Tipton Crossing	5 6	12,300	
Tulare	4 10	Safety items		3,080	
Tulare	10	Right of Way; Route 4 to Mill Creek	4 2	18,480	
Tulare-Kern	129	Deepwell Ranch to $\frac{1}{4}$ mile north of county line	8 0	215,650	
Tulare	129	Daley's Corner to Woodlake (portions); Yokohl Creek Bridge		49,290	
Tulare	132	Route 134 to Visalia	8 1	30,810	
Tulare		Various Drainage correction on Secondary Roads		6,160	
Tulare		Various Safety items on Secondary Roads		3,080	394,300
Tuolumne	13	$2\frac{1}{2}$ miles north of Keystone to south of Jamestown	7 5	91,100	91,100
Ventura	2	Junctions Route 60 and Route 9; and El Rio to Montalvo	1 7	57,920	
Ventura	2	Mandos Curve to Pitas Point	1 5	48,060	
Ventura	2	Drainage protection Montalvo to Ventura (portions)		18,480	
Ventura	9	Victoria Avenue and Saticoy Avenue intersections		11,100	
Ventura	9	Route 2 to Los Angeles County Line (portions)		6,160	
Ventura	9	Saticoy to Los Angeles Avenue	1 6	11,830	
Ventura	60	Point Mugu to Little Sycamore Creek		184,850	
Ventura	60	Fifth Street to 6th Street in Oxnard		49,300	
Ventura	79	Through Santa Paula		38,200	
Ventura	79	Sespe River Bridge		1,850	
Ventura	154	El Rio to Route 9 (portions)	3 6	5,300	
Ventura	155	Triumpho Creek Bridge		1,850	434,900
Yolo	6	Swingle to Yolo Causeway	1 7	109,250	
Yolo, Solano	6, 7	1.3 mile north of Dixon to 1 mile east of Davis (see Solano County)	7 5	(382,440)	
Yolo	6	$2\frac{1}{2}$ miles east of Yolo Causeway to Washington Subway	1 3	91,060	
Yolo	50	At Conway Canal $6\frac{1}{2}$ miles east of Woodland	0 3	45,500	
Yolo	50	$\frac{3}{4}$ mile south to $\frac{1}{3}$ mile north of Rumsey	1 2	35,210	
Yolo	50	Woodland to Kiesel (portions)	4 5	30,350	
Yolo	87	0.2 mile south to 0.5 mile north of Cache Creek	0 7	23,070	
Yolo	99	Solano County Line to Irrigation Canal (portions)		15,780	
Yolo	99	Irrigation Canal to Route 6 (portions)		24,280	374,500
Yuba, Sutter	3	Feather River Bridge Foundations (see Sutter County)		(424,950)	
Yuba, Nevada	25	Nevada City to Sierra County Line (portions)		123,800	123,800

GENERAL ITEMS, NORTHERN COUNTIES—93rd - 94th FISCAL YEARS

County	Routes	Location	Proposed expenditure for construction, right of way, engineering and contingencies
Counties Dist. I	Primary	Drainage corrections	$3,040
Counties Dist. I	Secondary	Install culverts	8,570
Counties Dist. I	Secondary	State Park Road improvements	5,340
Counties Dist. II	Secondary	Various safety items	3,640
Counties Dist. II	Secondary	Improving drainage	4,860
Counties Dist. II	Secondary	State Park Road improvements	1,090
Counties Dist. II	Primary	Various safety items	2,430
Counties Dist. II	Primary	Drainage improvements	8,500
Counties Dist. III	Primary	Safety items and drainage improvement	4,860
Counties Dist. III	Secondary	Safety items and drainage improvement	6,070
Counties Dist. III	Secondary	Install guard rail	2,430
Counties Dist. III	Secondary	State Park Road improvements	2,790
Counties Dist. IV	Primary	Drainage correction	6,070
Counties Dist. IV	Primary	Various safety items	10,800
Counties Dist. IV	Secondary	Drainage correction	6,070
Counties Dist. IV	Secondary	Various safety items	10,930
Counties Dist. IV	Secondary	State Park Road improvements	12,140
Counties Dist. V	Primary	Safety items and drainage correction	6,680
Counties Dist. V	Secondary	Safety items and drainage correction	7,280
Counties Dist. V	Secondary	State Park Road improvements	4,490
Counties Dist. VI	Primary	Various safety items	6,070
Counties Dist. VI	Secondary	Drainage correction	12,140
Counties Dist. VI	Secondary	Various safety items	6,070
Counties Dist. X	Primary	Drainage correction	3,640
Counties Dist. X	Primary	Various safety items	2,430
Counties Dist. X	Secondary	Various safety items	6,070
Counties Dist. X	Secondary	Drainage correction	6,070
Northern Districts	Primary	Landscaping and roadside improvement projects	42,500
Northern Districts	Secondary	Landscaping and roadside improvement projects	24,280
Northern Districts	Secondary	Emergency construction, repair or replacement of bridges failed and posted for less than legal loads	437,197
		Total General Items Northern Counties	$664,547

GENERAL ITEMS, SOUTHERN COUNTIES—93rd - 94th FISCAL YEARS

County	Routes	Location	Proposed expenditure for construction, right of way, engineering and contingencies
Counties Dist. V	Primary	Various safety items and drainage improvement	$6,160
Counties Dist. V	Secondary	Various safety items and drainage improvement	7,400
Counties Dist. V	Secondary	State Park Road improvements	5,300
Counties Dist. VII	Primary	Various safety items	12,320
Counties Dist. VII	Primary	Railroad grade crossing protection	8,630
Counties Dist. VII	Primary	Small Betterment Projects	18,480
Counties Dist. VII	Secondary	Various small grading, surfacing and drainage projects	12,320
Counties Dist. VII	Secondary	Various safety items	18,480
Counties Dist. VII	Secondary	Various small grading, surfacing and drainage projects	18,480
Counties Dist. VII	Secondary	State Park Road improvements	5,670
Counties Dist. IX	Primary	Various safety items	2,460
Counties Dist. IX	Secondary	Various safety items	620
Counties Dist. XI	Primary	Various safety items	9,240
Counties Dist. XI	Secondary	Various safety items	11,700
Southern Districts	Primary	Landscaping and roadside improvement projects	43,130
Southern Districts	Secondary	Landscaping and roadside improvement projects	55,450
Southern Districts	Secondary	Emergency construction, repair or replacement of bridges, failed and posted for less than legal loads	172,513
		Total General Items Southern Counties	$408,353

Highway Bids and Awards for December, 1940

IMPERIAL COUNTY—Between Sandy Beach Road and Truckhaven, about 8.8 miles to be graded, surfaced with plant-mixed surfacing, paved with asphalt concrete, existing bridges to be widened and a bridge to be constructed. District XI, Route 26, Sections C,D. Griffith Co., Los Angeles, $236,715; Oswald Bros., Los Angeles, $245,415; Radich & Brown, Burbank, $247,915; J. E. Haddock, Ltd., Pasadena, $249,800; V. R. Dennis Construction Co., San Diego, $280,205. Contract awarded to Basich Bros., Torrance, $207,577.

KERN COUNTY—Between Fort Tejon & 1.4 miles north of Grapevine Station, about 6 miles, existing roadbed to be widened and Portland cement concrete flumes to be constructed. District VI, Route 4, Section A. Oswald Bros., Los Angeles, $406,706; Macco Construction Co., Clearwater, $409,506; J. E. Haddock, Ltd., Pasadena, $412,046; Mittry Bros. Const. Co., Los Angeles, $412,262; Heafey-Moore Co. & Fredrickson & Watson Construction Co., Oakland, $421,969; A. Teichert & Son, Inc., Sacramento, $430,232; United Concrete Pipe Corp. & Ralph A. Bell, Los Angeles, $462,445; Fredricksen & Westbrook, Sacramento, $473,652; Rhoades Bros., Los Angeles, $486,632; Denni Investment Corp., Wilmington, $536,937. Contract awarded to Griffith Co., Los Angeles, $385,638.

LAKE COUNTY—Fence construction between 3 miles and 5.3 miles northeast of Putah Creek. District I, Route 49, Section B. Willard G. Curtis, Clear Lake Highlands, $4,743; John Burman & Sons, Eureka, $5,710; J. L. Conner & Sons, Calistoga, $5,365; Fred J. Maurer & Son, Eureka, $5,285. Contract awarded to Frank Embleton, Albany, $4,629.

LOS ANGELES COUNTY—On Bellflower Blvd., between Spring St. and South St. about 3.1 mile to be graded and surfaced with plant mixed surfacing. District VII, Route 169, Section A, Long Beach. Matich Bros., Elsinore, $63,406; Sully-Miller Contracting Co., Long Beach, $63,458; Griffith Co., Los Angeles, $64,195; Oswald Bros., Los Angeles, $64,330; Warren Southwest, Inc., Los Angeles, $76,720. Contract awarded to J. E. Haddock, Ltd., Pasadena, $59,316.

SAN BERNARDINO COUNTY—At Lytle Creek at West city limits of San Bernardino, existing steel and concrete bridge to be widened and about 0.3 mile of approaches to be resurfaced with plant-mixed surfacing. District VIII, Route 9, Section S.Bd.,C. J. E. Haddock, Ltd., Pasadena, $21,809; Byerts & Dunn, Los Angeles, $23,246. Contract awarded to J. S. Metzger & Son, Los Angeles, $21,333.

SANTA CRUZ COUNTY—Between Watsonville and Rob Roy Junction, about 6.2 miles to be graded and surfaced with selected material. District IV, Routes 32, 56, Section Wat.B.D. Granfield, Farrar & Carlin, San Francisco, $257,793; Macco Construction Co., Clearwater, $257,857; Fredricksen & Westbrook, Sacramento, $271,183; A. Teichert & Son, Inc., Sacramento, $273,462; Eaton & Smith, San Francisco, $273,755; Frederickson Bros., Emeryville, $278,136; Louis Biasotti & Son & Piombo Bros. & Co., San Francisco, $282,174; McNutt Bros., Eugene, Ore., $282,327; Heafey-Moore Co. & Fredrickson & Watson Const. Co., Oakland, $283,437; Earl W. Heple and Parish Bros., San Jose, $292,007; Mittry Brothers Const. Co., Los Angeles, $318,240; Clarence Crow and L. A. & R. S. Crow, Los Angeles, $339,792; Clyde W. Wood, Los Angeles, $346,068; Isbell Construction Co., Reno, Nevada, $351,362. Contract awarded to N. M. Ball Sons, Berkeley, $251,087.

SOLANO COUNTY—At Vallejo Creek near the city of Vallejo, about 0.6 mile north of the junction of Routes 74 and 7, about 0.1 mile to be graded and surfaced with plant-mixed surfacing on crusher run base and a reinforced concrete box culvert to be constructed. District X, Route 7, Section G. Louis Biasotti & Son, Stockton, $5,490; Helwig Construction Co., Sebastopol, $6,715; Albert H. Siemer & John Carcano, San Anselmo, $5,682; Carlton Gildersleeve, Berkeley, $5,999. Contract awarded to Lee J. Immel, Berkeley, $5,268.

Have You Moved?

If you have changed your post office address recently and wish to continue receiving **CALIFORNIA HIGHWAYS AND PUBLIC WORKS** magazine, a penny postal card stating your new address and sent to Post Office Box 1499, Sacramento, will ensure the continuance of your name on our mailing list.

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EXTREMELY INTERESTING

STATE OF OHIO
DEPARTMENT OF HIGHWAYS
Columbus

Mr. J. W. Howe, Editor
California Highways
and Public Works,
Sacramento, California.

Dear Sir:

Mr. A. F. Unckrich of the Portland Cement Association furnished us with a copy of a recent issue of "California Highways and Public Works," which we have found to be extremely interesting.

We would very much appreciate being placed on your mailing list so that we may receive this magazine periodically, and would also appreciate a copy of the August, 1940, issue.

Trusting that we may be favored with this request, I am

Very truly yours,
T. J. KAUER,
Engineer of Design.

Plumber: "Why do you want such a big sink?"

Man: "So there'll be plenty of room for the dishes when my wife goes away for a vacation."

Weed Eradication on Highways Cost $102,000 in 1939

SPREADING over orchards and fields, ditch banks, highways and almost every place a plant can grow, weeds annually cost the State sixty million dollars, not only for direct weed control but also in crop and livestock losses as well as increased cost of cultivating and handling agricultural products, according to a report of the State Department of Agriculture.

In 1939 the California Division of Highways spent $102,000 to control weeds and other vegetation along the State highways. That figure includes the cost of equipment and the labor of highway crews in eradication operations which many times result in a restriction of traffic.

TRAFFIC IS PROTECTED

When weeds are being burned along the ditches and fence line of the highway, the equipment necessarily occupies almost half of the road and the smoke makes visibility difficult for drivers. During these operations, flagmen are stationed at the point where the operations are under way to control and otherwise assist traffic to safely pass.

The figure sixty million dollars quoted above is an estimate given by Walter S. Ball of the State Department of Agriculture and Dr. W. W. Robbins of the University of California College of Agriculture in a published study on weed problems in this State.

They estimate that eight per cent of crop cultivation is necessary because of weeds and that in 1939 this cultivation cost the State's farmers nearly $25,000,000.

In 1939 one railroad company spent more than $20,000 to keep weeds off its right of way. Materials alone for controlling weeds on ditch banks during the past three years have cost $43,032, according to the report.

Big Car Increase in L. A. County

A leading reason for traffic difficulties in the Los Angeles area is that the county's motor vehicle registration represents about 41 per cent of the 2,773,698 State total and most of the vehicles are in daily use in the metropolitan region, says the Automobile Club of Southern California.

State of California

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Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

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CALIFORNIA STATE HIGHWAY SYSTEM

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Federal Defense Road Program In California Presents Serious Financial and Traffic Problems

By RICHARD H. WILSON, Office Engineer, Division of Highways

PROPOSED construction and improvement of highways for defense and military purposes hroughout the United States con'ront highway officials with serious problems of financing. These probems must be solved immediately if he program for development of necesary highways is to be consummated n the near future and in time to 'urnish adequate facilities to the nany camps now under construction.

The demands of Army and Navy uthorities for an articulated system of defense highways divide the program into three distinct phases. The argest order is the development of an dequate interlocking strategic road ystem throughout the entire Nation; he second phase requires the contruction of access roads connecting he numerous military cantonments, raining camps, naval and marine ases and reservations with the trategic system; and the third neessitates development of highways nd streets around industrial areas vhere increased activity caused by efense orders is resulting in trafic congestion.

MOST URGENT NEED

The most urgent need for the monent is for satisfactory access roads o the sites of cantonments, training amps, reservations and bases, as contruction of them is now progressing apidly.

While locations of industrial lants where defense orders are being lled are less widespread than the amps, nevertheless, traffic congestion n existing road facilities around uch plants presents a most serious roblem for immediate solution.

The problem of bringing the strateic road network to required military tandards within a reasonable time is lso most urgent and is of a most erious nature in that it will probably pset normal highway development rograms to a marked degree.

> **Access Roads First Says U. S. Authority**
>
> **A few months ago it was thought that the improvement of the strategic network, its 75,000 miles, with minor exceptions, coinciding with the most important traffic routes of the Nation, would be a matter of first concern. But now, according to Thos. H. MacDonald, U. S. Commissioner of Public Roads, the situation is "quite reversed." It has become apparent that access roads, and not the strategic network must be given first consideration.**
>
> **Mr. MacDonald explains: "A vast program of essential equipment, ordnance and military supplies is under way, necessitating many new plants and the enlargement and transformation for new uses of many old ones. The partial estimates now available indicate that the Army and Navy alone have need for 2,900 miles of access and reservation roads, which, if adequately improved, will cost around $200,000,000. The job of planning these access roads is under way, and in many cases the actual construction with the regularly available Federal and State funds is going forward.—*Better Roads.***

SPEEDY PROGRESS ESSENTIAL

To Californians, the effect of these three phases of the defense road program on the progressive expansion and improvement of the State Highway System is most important. That defense road construction be prosecuted rapidly with a minimum disruption to planned highway development on the State system as a whole is most essential. Some of the more pressing phases of the problems confronting California State highway officials in this connection are included in the following paragraphs.

Because California is a border State, it must of necessity be the locale of numerous military, marine, and naval bases. Because over large portions of the State, climatic conditions during the entire year are favorable for training operations, many sites for large cantonments and camps are being located in California by the Army, Navy and Marine Corps.

These military reservations and cantonments are now in the process of construction and the facilities being built are planned for housing and training of many hundred thousands of men. The construction of adequate access roads to serve these camps and bases is yet to be started.

ACCESS ROAD PRIORITY

Thomas H. MacDonald, United States Commissioner of Public Roads, in addressing the Asphalt Institute in Dallas, Texas, on December 10, 1940, stressed the priority of access road construction, particularly in border States. The Public Roads Administration has issued memoranda to all States, which outline the procedure for designation of specific roads as access roads to military camps, reservations and industrial areas.

In accordance with the memoranda, conferences have been called by commanding officers and held at various military camps, reservations, naval and marine bases situated in California. Present at these conferences have been representatives of the Army or Navy, the Public Roads Administration, the State Highway Department, the WPA, and various local agencies, such as cities and counties, concerned with specific projects.

The purpose of these meetings has been to determine the minimum re-

Factory parking area and traffic congestion on 4-lane U. S. Highway 101 at Consolidated Aircraft Corporation plant near San Diego

quirements in the matter of access roads for each of the individual camps, reservations, and bases and the priority in need of construction for each project.

FUNDS NOT AVAILABLE

The matter of availability of any funds that any of the agencies might have for use towards access road construction also was investigated at the conferences. In practically all instances, no money was available, with the possible exception, in some instances, of contributions by the WPA.

While all access roads for California have not been designated, at the present time it appears that in this State there will be a total of some 300 miles of such roads, including many bridges and expensive grade separation structures, which need construction. It is estimated that construction and right of way costs required for the program will amount to about $28,600,000.

Most of this access mileage is situated off the State highway system and expenditures of State highway funds for right of way and improvement to such roads is not possible under California statutes. This leaves the counties as the only source of local aid for financing such right of way and construction, and county road funds are almost completely exhausted in every instance.

SURVEY UNDER WAY

Under authority of the Public Roads Administration acting in accordance with provisions of the Federal Aid Highway Act of 1940, Federal funds allocated to California for regular Federal Aid and Feeder Road Construction were taken from the various scheduled projects and set up for the survey of the several access and tactical roads required by the marine, naval, and military camps and reservations.

Surveys are now in progress on practically all roads which have been agreed upon as included in the category of access roads at the various conferences. There still remain several proposed conferences which have not been called and which will undoubtedly require additional expenditures to provide access to camps now in course of construction.

In some instances WPA funds will be available for this type of defense work, such as certain roads within military reservations in the San Francisco Bay area and Fort Ord. Work on these roads will be supervised by the Public Roads Administration or the State Highway Department.

RIGHT OF WAY PROBLEM

In these instances right of way is not a problem, but as the majority of access roads are situated on county roads and the WPA Act does not allow expenditures for right of way, any assistance from the WPA is eliminated until right of way is obtained.

(Continued on page 4)

TENTATIVE LIST OF PROPOSED ACCESS ROADS IN DEFENSE PROGRAM

Location	Miles and Type	Estimated Construction Cost
ENICIA ARSENAL		
U. S. 40 near Vallejo to Arsenal Gate in Benicia	7 miles, grading and surfacing, 2 lanes	$225,000
Benicia northerly	4.5 miles, grade, surface and bridge, 2 lanes	300,000
ORT ORD		
Camp Ord to Salinas	4.9 miles, grade, surface and bridge, 4 lanes	1,000,000
Laguna Seco to State Route 117	1.7 miles, grade and surface, 2 lanes	45,000
Salinas to Salinas Airport	6.0 miles, grade and resurface, 2 lanes	200,000
State Sign Route 1, Del Monte Jct. to Castroville	14.5 miles, grade, pave, bridges and grade separation, 4 lanes, divided	2,010,000
Del Monte Ave., Monterey to Seaside Jct.	2.8 miles grade and pave, 4 lanes	250,000
State Sign Route 156, Castroville near Prunedale	5.2 miles, grade, surface and grade separation, 2 lanes	325,000
EARST RANCH RESERVATION		
Kings City to Jolon	18.2 miles, grade and surface, 2 lanes	840,000
Jolon to Bradley	21.5 miles, grade and surface, 2 lanes	750,000
Jolon to Coast	26.5 miles, grade and surface, 2 lanes	1,500,000
AN LUIS OBISPO NATIONAL GUARD CAMP		
State Sign Rte. 1 from San Luis Obispo to Camp San Luis Obispo	6.4 miles, grade and P.C.C. pave, Chorro Creek Br. and R. R. separation, 4 lanes, divided	730,000
County Road from San Luis Obispo to Camp San Luis Obispo via Osos Valley	5.4 miles, base and surfacing, 2 lanes	75,000
AMILTON FIELD		
	6.2 miles, grade and surface, 2 lanes, channelization	225,000
ACRAMENTO AIR DEPOT		
U. S. Air Depot to Government Docks on Sacramento River	10 miles, 60′ grading, 40′ base and surfacing	450,000
Air Depot to Mather Field	10.5 miles, 60′ grade, 40′ base and surface, American River Bridge	1,000,000
AN FRANCISCO AREA		
Moffett Field	Pedestrian separation on U. S. 101	20,000
Presidio, Fort Barry, Fort Funston, Fort Scott, Fort Miley, Fort Baker	Grade, surface, resurfacing various Post Roads	1,750,000
ARCH FIELD		
U. S. 395 from 1½ miles South March Field to U. S. 60	4.7 miles, grade and P.C.C. Pave, highway separation over U. S. 60, 4 lanes, divided	340,000
U. S. 60 from U. S. 395 to Riverside	4.1 miles, grade and P.C.C. pave widen R.R. separation, 4 lanes, divided	$375,000
Iowa Avenue from U. S. 60 to State Sign Route 18	3.1 miles, grade and surface 8″ improved shoulders, 2 lanes channelization	100,000
County Road, March Field-Riverside Mockingbird Canyon	12½ miles, surfacing (county project), 2 lanes	150,000
MUROC BOMBING FIELD		
From U. S. 395, about 12 miles south of Kramer to West Cantonment Area near Muroc	26 miles, grade, base and plant mixed surf., 2 lanes	600,000
MOJAVE DESERT ANTI-AIRCRAFT RANGE Bicycle Lake Access Road	35 miles, grade and surf., 2 lanes	700,000
LOS ANGELES, TERMINAL ISLAND		
From U. S. Fleet Operating Base to Willow Street	3.0 miles, grade and P.C.C. Pave, 6 lanes, divided, bridge and separations	5,750,000
SAN DIEGO AREA		
U. S. 101 from Market St. to 1 mile north of San Diego River	5.2 miles, grade and P.C.C., 6 lanes, divided, 2 pedestrian overheads, 3 highway separations, 3 bridge widenings	1,520,000
Relocated U. S. 395 from A St. to ½ mile south of City Limits	7.0 miles, grade and P.C.C. Pave, 4 and 6 lanes, divided, 6 lanes double bore tunnel University Avenue, 7 separation structures	1,925,000
In Fort Rosecrans from Ballast Point to Upper Cantonment	2.0 miles, grade and P.C.C. Pave, 2 and 4 lanes	170,000
Barnet Ave. from Rosecrans St. to U. S. 101	1.2 miles, grade and P.C.C. Pave, 4 lanes, divided	90,000
Harbor Drive, from U. S. Destroyer Base to Junction Rosecrans St. and Talbot Ave.	8.2 miles, grade and P.C.C. Pave, 4 lanes, divided, 4 structures	1,750,000
Rosecrans St., Lytton to Route 2	1.0 miles, grade and P.C.C. Pave, 4 lanes, divided	110,000
Route 2 to Route 11, with Spur connection from Camino del Rio to U. S. 101	2.2 miles, Grade and P.C.C. Pave, 4 lanes, divided	200,000
Subtotal		$25,475,000
Total Estimated R W Cost		2,483,000
Anticipated Access Roads at Mare Island, Torrey Pines and Camp McQuaide, Stockton		600,000
GRAND TOTAL ESTIMATED COST		$28,558,000

Congestion of traffic on Atlantic Boulevard north of Long Beach where thousands of workers are employed in the Vultee airplane plant

If access road construction is to be accomplished immediately, and immediate action is most necessary, the funds must be provided by early Congressional appropriation of money in sufficient amount to care for both right of way and construction.

Access roads to most of the camps are just as much required facilities as are barracks and administration buildings, and the cost of access road construction should be borne by Federal appropriations.

The accompanying tentative list of proposed access roads shows the location and desired improvements and estimated cost. This list does not, however, include certain defense roads in addition to the access roads shown which are being or will be constructed by the WPA.

A conception of the traffic load which these access roads will be called upon to carry may be had from the following official estimates of activities at a few of the camps and industrial plants served by such access roads.

6,000 MEN EMPLOYED

Construction operations now under way at Camp San Luis Obispo require the employment of approximately 6,000 at the camp. About 60 per cent of these men travel back and forth daily between the camp and San Luis Obispo.

Traffic on January 10 of this year amounted to 1,020 vehicles per hour. Future traffic on the road will probably increase by 4,000 or 5,000 vehicles daily when the camp is up to the planned strength of 20,000 men. It is expected that this will be about March 15.

Plans for the camp anticipate some 2,600 motor vehicles as military equipment and about 2,500 private cars for officers and men. Movement artillery units from Camp San Luis Obispo to the artillery range near Jolon in Monterey County, a distance of 87 miles, will result in long lines of traffic over the highway about once a week, as well as continual movement of supply trucks between the camp and the range.

HOUSE 30,000 TROOPS

Camp Nacimiento which is now under construction in the upper Salinas Valley is expected to house 30,000 troops with some 1,500 or 2,000 motor vehicles. At the present time there are about 7,000 men working at the camp and maximum traffic to and from San Miguel amounts to some 1,200 cars per hour. With the camp in full operation, this congestion will be greatly increased.

The two garrisons at Fort Ord between Salinas and the coast are planned for about 50,000 men by the end of May or the first part of June. This camp will require approximately 3,000 army vehicles and a number of privately owned vehicles will probably exceed the army equipment.

With some 14,000 civilian workers and troops now stationed at the garrisons, traffic congestion is quite serious at the time of shift changes and movement of a convoy of army trucks between Monterey or Salinas and the camp. When the camp is in full operation, traffic conditions will be much worse in the evenings and when roop movements are in progress to nd from the Jolon range.

It is anticipated that troop convoys will be as much as ten miles in ngth, which, with present two-lane cilities, will practically eliminate vilian traffic.

ARTILLERY RANGE TRAFFIC

The Hearst Military Reservation : Jolon in Monterey County is the te of the artillery range, and while ɔ large permanent encampment is lanned for this site, the movement f some 2,000 vehicles to the range rom the surrounding camps every w days will periodically disturb ɔrmal traffic.

In Riverside County, on the Riverde-Perris Road are situated March ield and Camp Haan.

Camp Haan is an anti-aircraft unit ɔr the training of draftees and is ɔcated on the Perris Road about ıree miles south of the junction with ıe State highway between Riverside ıd Beaumont.

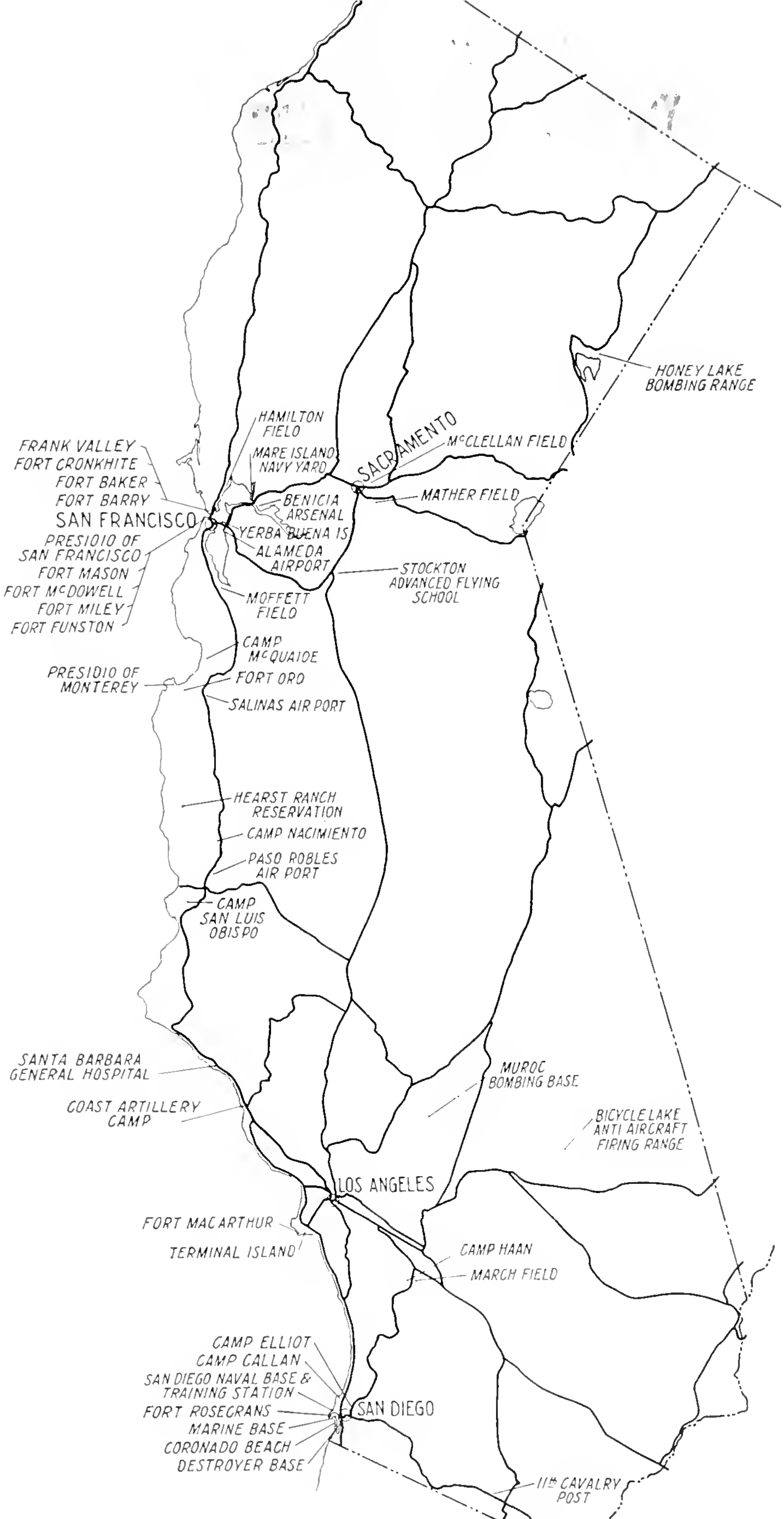
It is anticipated that at this camp ill be stationed from 15,000 to 17,-)0 men. Excluding military trucks ıd equipment there will be some 000 private cars at the camp and ɔme 400 additional vehicles will ravel to the camp daily carrying cilian workers and furnishing local ıpplies.

It is expected that around 10,000) 12,000 of the personnel will leave ıe camp week ends to spend their ee time in the various local comunities and in Los Angeles. This igration will require a great number f buses to serve the camp at that me.

Periodically a regiment will be ɔoved from the camp to the firing ange at Bicycle Lake, north of arstow. This will involve a two-way ɔovement of a caravan about seven iles long, moving at a rate of aproximately 25 miles per hour over ıe 130 miles from the camp to Biycle Lake.

FROM MARCH FIELD AREA

March field is a Military Aviation eservation situated on the northeastrly side of the Perris highway oppoite Camp Haan. While only a ersonnel of 7,000 men is anticipated ɔr March Field, it will proportionately contribute to highway congeson in this vicinity, particularly vhen large units move to the bombing ange at Muroc, 120 miles northerly.



Camps, cantonments and military reservations in California on Defense Program

Traffic to and from March Field Military Aviation Reservation and Camp Haan on Perris Highway in Riverside County

It is estimated that by early summer when both camps are in full operation traffic will average about 8,000 cars daily.

On Torrey Pines Mesa north of San Diego, Camp Callan is now under construction, preparing for 9,000 men by July first. When the camp is in operation, it is estimated that the daily average of trucks serving the camp will be about 300 per day. The main entrance to Camp Callan will open on the old Biological Grade some 600 feet off U. S. 101, and traffic from the camp will undoubtedly cause congestion at the junction of Miramar Road and U. S. 101.

CONGESTION IN SAN DIEGO

In the City of San Diego U. S. 101 passes the plant of the Consolidated Aircraft Corporation, the Ryan and the Solar Aircraft Companies and also serves traffic from the nearby Marine Corps Base and the Naval Training Station, Torrey Pines and Fort Rosecrans. Traffic congestion from these various sources presents a most serious problem at this time and certainly will become more aggravated with expansion of the plants and military bases.

In close proximity to these sites there is also to be a proposed Naval Housing Project and a 5,000 unit housing project on the mesa near Chesterton for workers in this vicinity which will both materially add to traffic volumes.

The Consolidated Aircraft Corporation, situated on U. S. 101, presents a typical example of the rapid expansion of war industry. In 1935 this plant had 300 employees, by December, 1939, these had increased to 3,200 and on January 21, 1941, the number was 15,000, 9,000 on the day shift and 6,000 on the night shift.

TIES UP TRAFFIC

The capacity of the plant will soon reach a maximum of 20,000 and a second plant is under construction nearby on U. S. 101. At the present time the 15,000 employees park 5,500 cars in the lot across the highway from the plant and at the times of shift changes the congestion resulting from the workers walking across U. S. 101 to the parking lot and the cars moving on and off the lot completely ties up traffic on this main artery.

These are briefly some of the problems confronting the Division of Highways in access road construction and for which no definite funds are available.

Conditions similar to that at the Consolidated Aircraft Corporation in San Diego exist on other highways and streets around industrial plants as at the Lockheed plant in Burbank, the Douglas plant near Santa Monica, the Vultee plant north of Long Beach, and many other industrial sites located on main highways. To relieve congestion at these locations will require construction of the highest type of highway facilities and in many instances there is some doubt as to the permanency of the congestion. The State, city or county should not be held responsible for the complete financing of such improvements without very material assistance from the Federal Government.

STRATEGIC SYSTEM ROADS

The problem of bringing the designated strategic system of highways up to the standards required by the War Department is equally as important.

The strategic highway system in California totals approximately 5,600 miles, most of which is located on the Federal Aid System or major State

Movement of heavy mechanized army equipment such as above stops all other traffic over that road

ghways. The majority of the im-
roved roads in this State conform to
ne standards specified by the Fed-
ral Government with the exception
f shoulder widths and some bridges.
There are about 2,000 miles of sub-
andard sections on the system in
alifornia and some 650 bridges be-
w the required minimum of an H15
ading on secondary roads and the
referable H20 on more heavily trav-
ed roads.

Estimates made by State highway
ngineers at the request of the Public
oads Administration show that ap-
roximately $150,000,000 will be nec-
ssary to bring the strategic system in
alifornia up to the required stand-
rds. This amount is entirely in ad-
ition to the needs for access roads.

These improvements must be taken
nto consideration in the allocation
f Federal funds apportioned to Cal-
ornia under the Federal Aid Act.
egular Federal Aid apportionments
o California for the fiscal years end-
ng June 30, 1942 and 1943 will
mount to only $7,600,000, and this
mount is about 10 per cent less than
his State received for the previous

(Continued on page 26)

Typical scene on access roads to camps and cantonments

$2,256,000 Bay Bridge Bonds to Be Retired, Saving $90,240 Annually

SAN FRANCISCO-OAKLAND Bay Toll Bridge sinking fund bonds having a par value of $2,256,000 and due September 1, 1976, will be retired ahead of schedule on March 1st, by exercise of the call privilege. This accomplishment after four years and three and one-half months of operations and four toll reductions since June, 1939, effected by Governor Culbert L. Olson as chairman of the California Toll Bridge Authority is but one of many outstanding events in the financial history of this remarkably successful public ownership project.

Much has been said and written concerning the engineering features of the bridge; that its foundations are the largest and deepest on record; its tunnel the world's largest in diameter of bore and its main cantilever span the longest and heaviest of that type in the United States.

To cope with these probems successfully and to accomplish within reasonable financial limits what most laymen and many engineers considered to be impossible, it was necessary to develop new theories of design and new construction methods. That the bridge was completed well ahead of schedule and at a saving of $7,000,000 is ample evidence of the careful design and engineering skill which went into the project.

REVENUE BOND PROJECT

Remarkable as the engineering features of the bridge may be, its financial record is even more outstanding. In considering the original financing of the project it should be remembered that in 1932 the theory of financing projects of this type through the issuance of revenue bonds was comparatively new and untried, and it is doubtful if public support could have been secured for such a large project on that basis.

Fortunately, after much negotiation, the Reconstruction Finance Corporation agreed to purchase a sufficient amount of bonds to yield the California Toll Bridge Authority the sum of $62,050,000 for the purpose of constructing the bridge. The interest rate was fixed at 5 per cent.

Ground was broken for the project on July 9, 1933.

As of April 1, 1934, the interest rate on self-liquidating loans made by the R. F. C. was reduced for a period of five years to 4 per cent, thereby effecting a considerable saving in interest during construction. The reduction was later extended to cover the entire period that the bonds were held by the R. F. C.

NEW AGREEMENT SECURED

In the original agreement with the R. F. C. the Bridge Authority expressed the intension of requesting the purchase of additional bonds to provide for the construction of interurban rail facilities on the bridge. In accordance with this understanding a new agreement was entered into on April 21, 1938, providing for the cancellation of the old bonds and for the issuance of $73,000,000 of new revenue bonds to complete the financing of the vehicular bridge and interurban facilities.

A saving in future interest charges was thus effected in that the new agreement provided for the issuance of $33,000,000 of serial revenue bonds bearing 4 per cent interest and $40,000,000 of sinking fund bonds bearing 4¼ per cent interest. Anticipating the possible sale of the bonds by the R. F. C. it was also agreed that the Bridge Authority would on behalf of the San Francisco-Oakland Bay Bridge, share equally with the R. F. C. in any profit made on the sale of the bonds at more than 101.

On June 5, 1939, the bond agreement with the R. F. C. was again amended reducing the interest rate on the serial revenue bonds from 4¼ per cent to 4 per cent. On June 22, 1939, the R. F. C. sold $31,700,000 of the serial bonds and $39,300,000 of the sinking funds at 103 with a resulting profit of $2,130,000 of which $1,065,000 was applied as a credit to the San Francisco-Oakland Bay Bridge.

$1,500,000 BONDS RETIRED

Serial bonds amounting to $500,000 had been retired on March 1, 1939, and on June 22, 1939, the $1,065,000 combined with $500,000 of funds not needed in the Bridge Construction Fund was used to retire $800,000 of serial bonds and $700,000 of sinking fund thereby reducing the bonds outstanding to the $71,000,000 of bonds which were sold by the R. F. C. to a syndicate and through the syndicate to the public.

These transactions bring the financing phase of the project up to date except for the retirement of $260,000 of serial bonds which matured on March 1, 1940, and were redeemed on that date in accordance with the retirement schedule.

Results from the operation of the bridge have exceeded the most optimistic estimates made during its developmental stages. It was opened to traffic on November 12, 1936, with the toll for passenger cars fixed at 65 cents per car and driver and 5 cents for each additional passenger.

By February 1, 1937, the traffic and revenues had been such that a flat rate of 50 cents was established with no charge for additional passengers and with corresponding reductions in the rates for trucks and freight.

FOUR MORE REDUCTIONS

These basic rates were again reduced by Governor Olson's initiative through the Toll Bridge Authority to 40 cents on June 15, 1939; to 35 cents on January 1, 1940; to 30 cents on May 25, 1940, and to 25 cents on July 1, 1940.

In spite of the substantial reductions that have been effected in the toll rates the bridge has during the short four and one-third year period of its operation not only built up the entire reserve of $4,000,000 that is required by the bond indenture but excess funds have been avail-

(Continued on page 16)

Highway Men Answer Call to Colors

THIRTY-NINE employees of the Division of Highways of the State Department of Public Works have answered the call to the colors and have enlisted in the military service of their country.

They have been granted leaves for the duration at the end of which they may return to their positions which will be held for them. During their absence, their jobs either will be filled by eligibles drawn from the Civil Service list of the Personnel Board or their work will be performed by personnel in the departments with which they were associated.

MANY TRAINED ENGINEERS

Many of those who have gone into army service are trained engineers whose services are required by the War Department. Others are enrollees under National conscription and some have been commissioned.

One employee of the Division of Water Resources has been called to duty. He is Assistant Hydraulic Engineer David B. Willets, a first lieutenant in the Ordnance Reserve, who has been assigned to the Chief of Ordnance at Washington, D. C.

A number of other employees of the Department of Public Works are Reserve Officers and expect a call in the near future.

The names on the Honor Roll of the Division of Highways to date and the departments with which they are connected, are as follows:

Central Office

Cullivan, Raymond ---- Junior Clerk
Packard, L. D. ---- Associate Highway Engineer

Bridge Department

Barnes, F. M. ---- Associate Bridge Engineer
Cordero, F. P. ---- Junior Bridge Engineer
Ferns, John H. ---- Junior Bridge Engineer
Haight, William T. ---- Associate Bridge Engineer
Howard, Thomas L. ---- Assistant Bridge Engineer
Miller, DeWolfe ---- Assistant Bridge Engineer
Murphy, R. P. ---- Junior Bridge Engineer
Payson, Stephen ---- Assistant Bridge Engineer
Sagehorn, E. H. ---- Junior Bridge Engineer
Silliman, J. W. ---- Assistant Bridge Engineer
Walters, Gordon ---- Structural Engineering Office Aid
Willett, Albert B. ---- Associate Bridge Engineer

San Francisco-Oakland Bay Bridge

Gray, James N. ---- Toll Collector
Mapes, Lynne R. ---- Toll Collector
Morian, Harold L. ---- Junior Bridge Engineer

Testing Laboratory

Geib, William S. ---- Junior Physical Testing Engineer

Planning Survey

Zook, Harry ---- Junior Engineering Aid

Highway Districts

Bates, Thad J., Jr. ---- Junior Clerk, District IV
Charle, Julien R. ---- Title Draftsman Delineator, VII
Daswell, L. H. ---- Highway Maintenance Leadingman, X
Davis, Cedric B. ---- Timekeeper-Clerk, XI
Freeman, Edgar M. ---- Laborer, III
Hon, Richard ---- Junior Highway Engineer, X
Laughter, Fred W. ---- Laborer, XI
Longfellow, E. S. ---- Junior Highway Engineer, IX
McCrea, John A. ---- Laborer, IV
McQueeney, Raymond T. ---- Timekeeper-Clerk, VIII
Mohr, William H. ---- Junior Highway Engineer, VII
Nicholson, R. N. ---- Junior Engineering Aid, X
Rowe, Harry C. ---- Junior Highway Engineer, IV
Sedgwick, W. D. ---- Associate Highway Engineer, X
Shafter, E. A. ---- Junior Highway Engineer, IX
Webb, Harry J. ---- Junior Highway Engineer, X
West, Melbourne H. ---- Junior Highway Engineer, XI
Wing, R. W. ---- Laborer, IV

Equipment Shops

Ames, Charles S. ---- Junior Mechanical Engineering Draftsman (Headquarters Shop)
Darling, W. V., Jr. ---- Heavy Equipment Mechanic, VIII

Snow surveyors learn to be good cross-country skiers. Rangers Smith and Rogers climbing grade en route to Chilkoot Lake

First Snow Survey Completed

By FRED H. PAGET, Associate Hydraulic Engineer

ONE after the other, like the waves of the ocean, in from the Pacific this winter came storm after storm. From the middle of December until almost the close of January the succession was unending. December was the wettest December ever recorded in California. Many of the January figures exceeded the normal for that month. Rain and more rain fell in the valleys and foothills of the State.

And while all this rain was falling in the lowlands, what was going on up in the mountains? In California during the winter, rain at low elevations usually means snow higher up and this season's weather has been no exception to that general rule. The skiers that flock to the hills as soon as the first patches of white appear on the hillsides brought back word of lots of snow. While the rain was making records in the lowlands, the snowfall was keeping pace in the mountains and the big white flakes floating down in their myriad millions had covered the Sierra with a dense blanket of snow many feet deep.

And this snow, the joy of the skiers, is also a boon to the farms and industries of California. When winter ends and summer comes with its months of sunny weather, the irrigationist and the industrialist have to depend to a great degree upon the melting snowpack to furnish them with the steady supply of water vital to their existence.

FIRST MEASUREMENTS MADE

These water using organizations keep an anxious eye on the snowpack all winter and not satisfied with general statements of conditions, they cooperate with the Division of Water Resources of the State Department of Public Works to secure periodically accurate measurements not only of the average depth of the snow over whole watersheds but, also, of the amount of water contained in the snowpack. The first series of this winter's measurements at many key locations in each watershed has just been completed and the situation analyzed.

The deepest snow measured was on the snow course near Lake Helen, on the southerly slopes of Mt. Lassen at an elevation of 8400 feet. Here measurements revealed an average snow depth on the level of 195 inches, containing 78 inches of water. Mount Shasta at 8000 feet reported 152 inches of snow with 64 inches of water—slightly more than the normal supply for the entire winter at this location.

At the Donner Summit, the high point of U. S. Highway 40 between Sacramento and Reno the measurements averaged an even 8 feet of snow—96 inches—with a water con-

Snow surveyors on the job. 1. Paget of State Division of Water Resources and Ranger Madsen gliding down slope. 2. Weighing core of snow taken in aluminum measuring tube as shown in picture 3. Two ways of obtaining drinking water in the snow country are shown in 4 and 5. Ranger Madsen gets snow at cabin door for melting down. Ranger Smith risks filling can from channel 8 feet below

Snow surveyors arrive at cabin in Sierra National Forest en route to San Joaquin watershed country

tent of 37 inches. Normal water content there for the whole season is 42 inches.

RESULTS ABOVE NORMAL

At the southern end of the Sierra, measurements in the Kern River Watershed at Round Meadow, elevation 9000 feet, showed an average snow depth of 65 inches, containing 23 inches of water. The normal for the entire winter at this station is 28 inches of water. Throughout the Sierra, very few stations above 6000 feet reported less than 20 inches of water in the snowpack; most stations reporting over 30 inches.

The average water content in most of the mountain watersheds now approximates 70 per cent of the total seasonal normal; a very healthy condition at the first of February when usually only about one half of the season's supply is expected to be on the ground. With the almost certain prospect of more snow during the next two months it would seem that an adequate water supply for all normal requirements of the 1941 season is already assured.

In measuring the snowpack at the end of January, men sent out by the Division of Water Resources were aided by the field forces of many other organizations. Irrigation district men, power company employees, and the forest and park rangers of the Federal services all helped with the snow surveys. A break in the weather during the last week in January favored the field work and the men had good weather and traveling conditions while carrying out their assignments. The field notes of their measurements were forwarded to Sacramento immediately upon their return from the snowfields.

FIRST BULLETIN ISSUED

A bulletin issued by the State Division of Water Resources on February 10th sets forth in detail all measurements made during this first checkup on the snowpack. No forecasts of runoff are included in this winter's first snow survey bulletin as the present snowpack will no doubt change considerably during the remaining two months of winter.

Another progress measurement will be made and another bulletin issued early in March. At the end of March the detailed snow survey of the total winter's snowpack will be made at all snow measuring stations throughout California and from the information gathered will be made forecasts of runoff of the Sierra streams for the coming spring and summer. These forecasts will be contained in the snow survey bulletin to be published on or about April 10th. All bulletins are available upon request to State Division of Water Resources.

Some of the more hardy snow surveyors, not minding the additional weight upon their backs, took along their cameras on the trips. On this and the opposite page are reproduced a few of the pictures they brought back.

Four More States Bar Diversion of Gas Taxes

Constitutional amendments prohibiting diversion of highway funds to non-highway purposes were adopted by four States in 1940. This is the largest number of States to take such action in any single year.

At the November election the amendments were adopted by Nevada, Idaho and South Dakota, while North Dakota adopted a like measure in June. The previous record year was 1938, when anti-diversion amendments were adopted by California, Michigan and New Hampshire.

Easterly Gateway to Los Angeles Involves Structure for Freeways

By A. N. GEORGE, District Construction Engineer

ONE of the most congested routes into down-town Los Angeles feeds traffic into the Civic Center and business section over the Aliso Street Bridge across the Los Angeles River.

The need of improved facilities for carrying Aliso Street traffic over the Los Angeles River and adjacent main line railroad tracks has been evident for many years.

The old bridge carried the double track lines of the Pacific Electric Railway Company which serve all of their lines to the east and northeast of the city, together with a single lane of highway traffic in each direction.

This bridge carried the traffic of State Highway Route 26, the Los Angeles to Pomona arterial, also U. S. 60 and 70 transcontinentals through Imperial Valley, and U. S. 99 from the Mexican border to Canada, besides other traffic originating east and north of the Los Angeles area.

The bridge, recently demolished to make way for new construction, spanned only the river and traffic was obliged to cross at grade the Santa Fe main line tracks to San Diego on the west side of the river and the Union Pacific tracks on the east side.

Aliso Street passes immediately southerly of the new union depot and leads directly towards the Civic Center of Los Angeles. Plans are now under way for extending Aliso Street into and across the Civic Center, which will make it one of the most important thoroughfares of the city.

A COMPLICATED PROBLEM

Active efforts to finance the construction were started by the City of Los Angeles in 1937. The financing was extremely difficult due to the many private organizations whose facilities would be involved and who would benefit by the proposed construction to such an extent that it was proper to expect them to contribute largely to the proposed construction.

Early plans for the project contemplated a single span across the river at a higher elevation than the original bridge which would provide for a separation of grades between the traffic using the bridge and the Santa Fe and Union Pacific tracks which paralled the river.

These early plans also contemplated carrying the Pacific Electric Railway tracks above the north roadway of State Highway Route 26 on to their private right of way which is parallel to and on the north side of the highway for some distance east of this point.

The plans also provided for carrying Mission Road under both the highway and the Pacific Electric tracks and to provide ramp connections with Mission Road for automobile traffic.

TWO FREEWAYS INVOLVED

Meantime plans for the ultimate construction of a freeway to Pomona utilizing portions of the alignment of

Construction begun on western approach to Aliso Street Bridge over Los Angeles River and distribution structure

River Span and Distribution Structure to Carry Traffic of T

Ramona Boulevard and a freeway to Santa Ana which would have its main entrance to Los Angeles by way of the proposed structure over Aliso Street have forced the inclusion of a rather elaborate distribution structure on the east side of the Los Angeles River as a part of the Aliso Street Project. The project is further complicated by the fact that the present route over Ramona Boulevard occupies the low land which originally drained a large area of the city.

With the construction of Ramona Boulevard this drainage was carried in a gunite lined ditch between the highway and the Pacific Electric. However, the plan for the Pomona freeway will not leave sufficient room for this open ditch and an item of $200,000 has been included in the current biennium budget for the construction of a reinforced concrete box to carry this drainage.

WPA PROVIDED SOLUTION

Many conferences were held which were attended by representatives of the Los Angeles City Engineer's Office; the Union Pacific Railway; the Santa Fe Railway; the Pacific Electric Railway; the State Highway department and various Federal agencies.

An attempt was made to finance it with the help of a PWA grant, the City, County and three railroads to combine in furnishing the money necessary to match the proposed Federal grant.

This attempt was unsuccessful and financing under a PWA grant failed due to the rigid time limit which was placed on all PWA projects by the Federal Government, there being insufficient time to get the plans completed and a contract awarded and the construction completed prior to the deadline set by the Federal Government for the completion of all PWA projects.

OFFERS RELIEF EMPLOYMENT

The need for employment in the metropolitan area to help reduce the relief rolls was so acute that an application was then made to the WPA authorities that this project be carried out under a WPA allotment and unusually liberal terms were arranged for the allotment. This method of financing and construction was finally agreed upon and the project is now being constructed under WPA authority.

The Los Angeles City Engineer's office have prepared the plans and are furnishing the engineering supervision for the construction work.

The original financing from other than Federal funds for the project which did not provide for the full distribution structure on the east, was predicated on the following contributions:

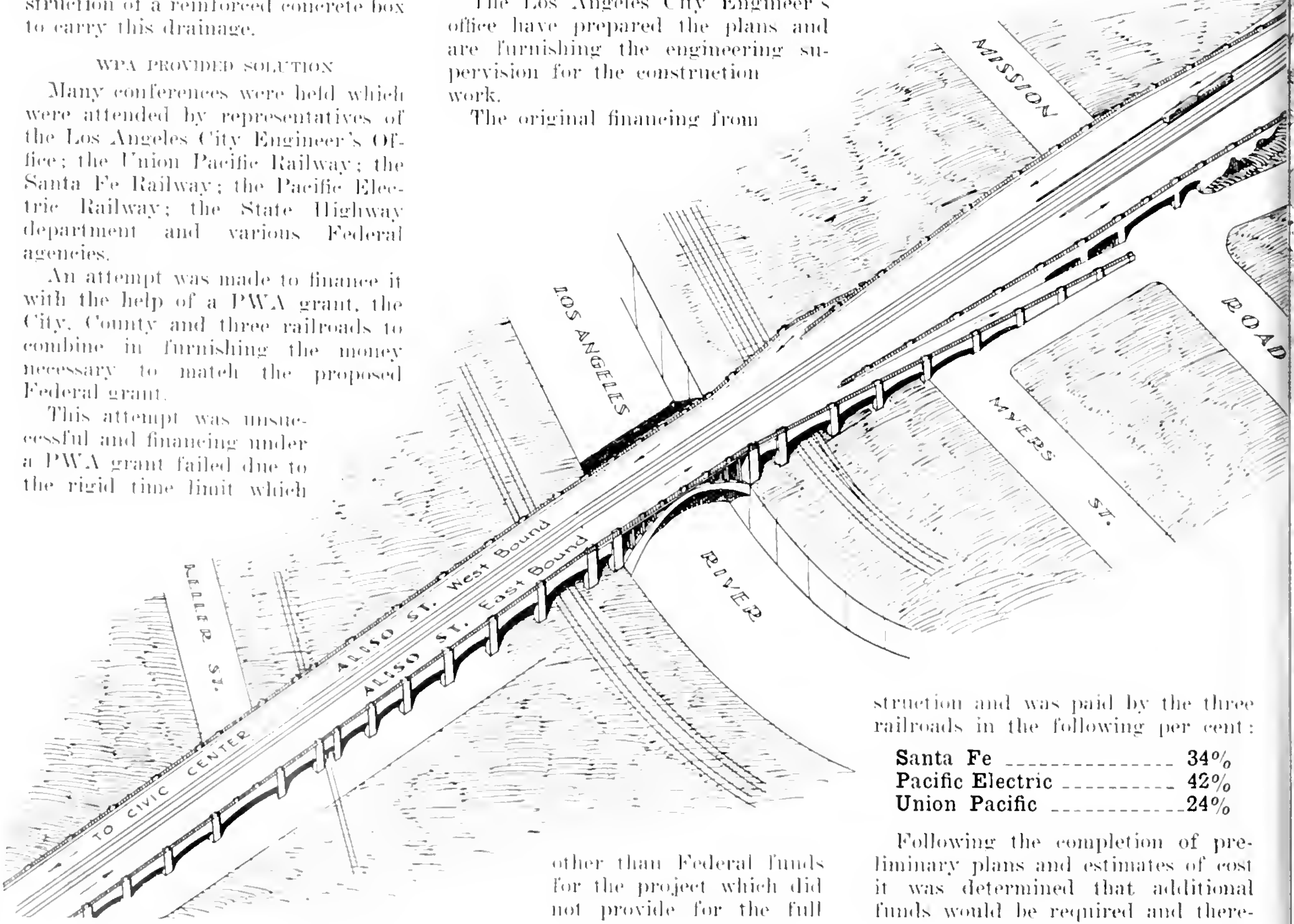
Railroads	$450,000
Los Angeles County	220,000
Los Angeles City from ¼¢ City Street funds	220,000
State Highway funds	220,000
Total	$1,110,000

RAILROADS SHAVE EXPENSE

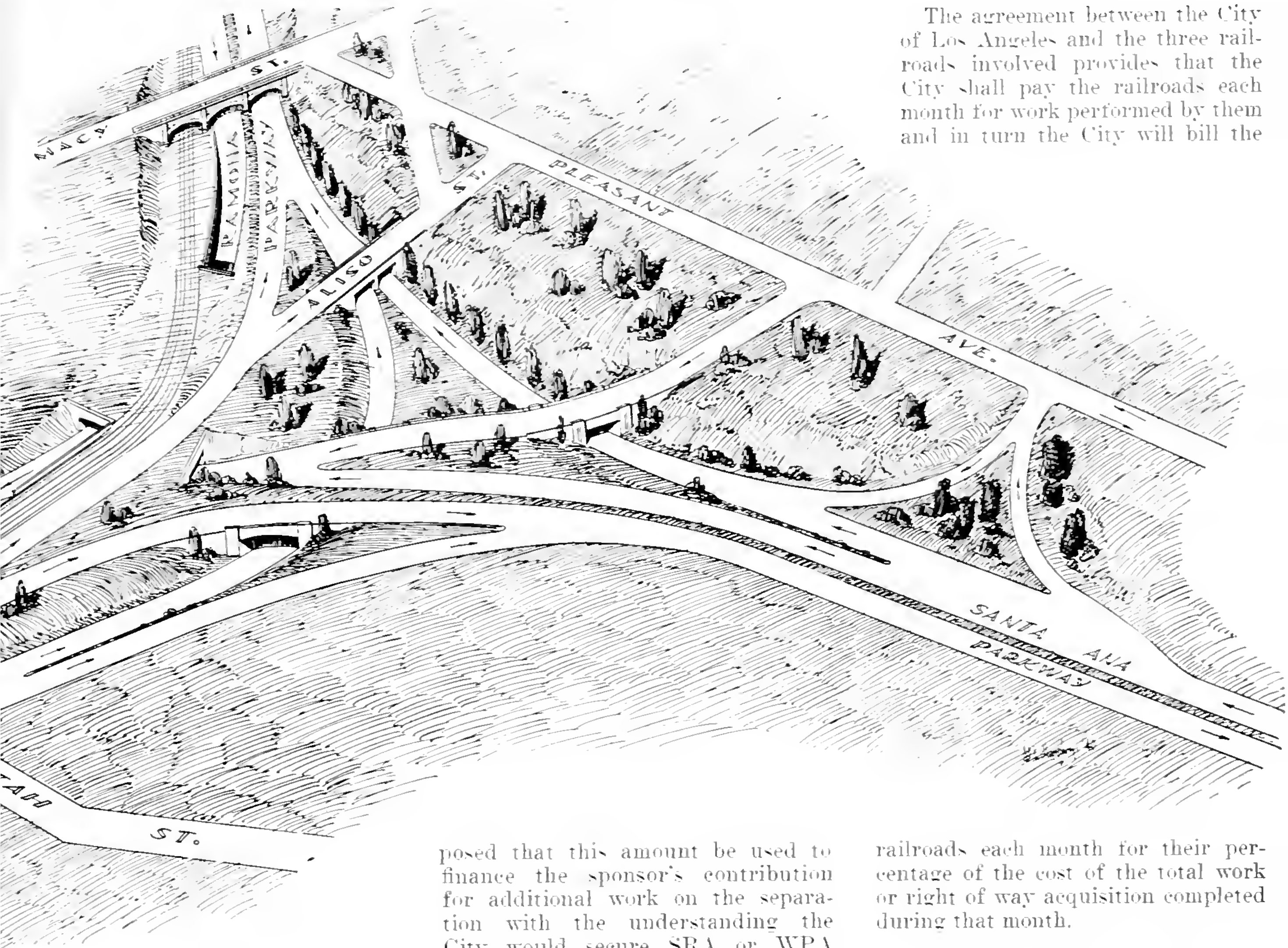
The railroads' contribution was based on 40.54% of the cost of right of way acquisition and the same per cent of the sponsor's cost of construction and was paid by the three railroads in the following per cent:

Santa Fe	34%
Pacific Electric	42%
Union Pacific	24%

Following the completion of preliminary plans and estimates of cost it was determined that additional funds would be required and there-



Freeways Into Civic Center of Los Angeles at Aliso Street



Drawing by W. L. Humphreys

fore the State's contribution was increased to $291,223, the County's contribution to $291,000, and the city's contribution from ¼-cent City Street funds to a like amount, and $1,256,187 provided from the WPA.

Before the completion of final plans it became apparent that provision should be made at the easterly end for a connection with the proposed Santa Ana Freeway towards Orange County which necessitated an increased sponsor's contribution.

As the 1939-41 biennium budget included $200,000 of State Highway funds to construct a storm drain along Ramona Boulevard (State Highway Route 26), the City proposed that this amount be used to finance the sponsor's contribution for additional work on the separation with the understanding the City would secure SRA or WPA labor and contributions to construct the Ramona Boulevard storm drain without any additional cost to the State.

FINANCING SET-UP

The financing now stands as follows:

Railroad funds	$550,271
County funds	291,000
Los Angeles City ¼c City Street funds	291,000
State Highway funds	491,223
WPA funds	1,981,002
Total	$3,604,496

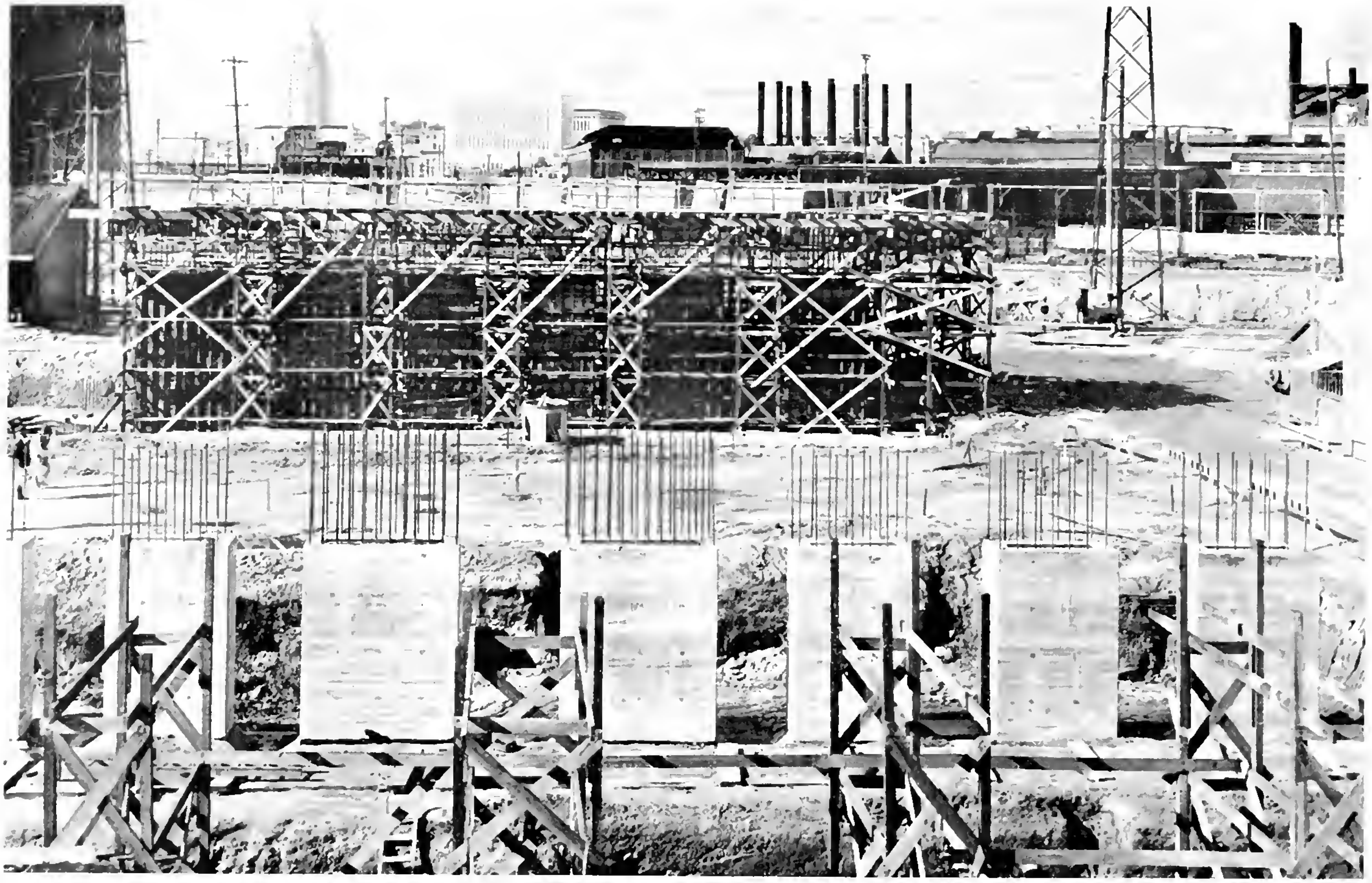
The railroads' proportion of the total cost of the sponsor's contribution as now provided is 40.54% of the total cost of the right of way and 32.64% of the total sponsor's contribution for construction.

The agreement between the City of Los Angeles and the three railroads involved provides that the City shall pay the railroads each month for work performed by them and in turn the City will bill the railroads each month for their percentage of the cost of the total work or right of way acquisition completed during that month.

ACTUAL CONSTRUCTION BEGUN

Work was started on this project on December 14, 1939, by the construction of a shoofly to carry the Pacific Electric around the work by way of Macy Street bridge, but ground breaking for the construction work itself was celebrated on February 20, 1940, at which time actual construction work on the new project was started.

To date the Pacific Electric has built their shoofly track around the construction; the Santa Fe and Union Pacific Railroads have lowered their tracks to a temporary location during construction work. The retaining walls for the westerly approach to the bridge have been completed and the footings and piers are nearly completed for that part of the structure. The deck to the west-



Footings poured on the easterly approach to Aliso Street Bridge and distribution structure. Los Angeles City Hall and State Building in background

erly approach will be started in the very near future.

Work is now in progress on the easterly footings for the river span section of the bridge and a portion of the footing has been poured. No work is proposed to be done on the westerly river span footing until April, 1941, because of the hazard of high water during the winter months. Work is being carried on on the footings and piers for the easterly approach.

It is proposed to push the work on the distribution structure to the east. Meanwhile work is advancing on the Ramona storm drain. Connection to the river from East Mission Road has already been made by means of tunneling under the maze of railroad tracks and roadways which it was necessary to cross, and the main storm drain structure is completed from the river to the Macy Street bridge.

Ramona Boulevard has been closed to traffic from St. Louis Street westerly and it is not anticipated that it will be possible to reopen it for approximately one year.

The completion of this structure will relieve much of the congestion of traffic to the east of Los Angeles and will be a notable milestone in the efforts to make it possible for traffic to flow smoothly, swiftly and safely into and out of the business district of Los Angeles.

$2,256,000 Bay Bridge Bonds to be Retired

(Continued from page 8)

able and used for the purpose of purchasing $931,000 par value of its bonds in the market thereby effecting a saving in annual interest charges of $37,360.

Now additional excess funds are available to retire $2,256,000 of the sinking fund bonds by call on March 1st which will make a further saving of $90,240 annually.

During the next year, therefore, the saving in interest resulting from the retirement to date of bonds ahead of schedule will amount to $127,600. Additional savings will be effected by the retirement in the same manner of approximately $1,000,000 of bonds on September 1, 1941.

At the dedication ceremonies in 1936 this statement was made: "By 1950 we estimate the bridge will be carrying 12,600,000 automobiles and trucks per year."

During the year ending December 31, 1940, ten years sooner, over 15,264,000 vehicles crossed the bridge or 25 per cent more than was predicted for bridge traffic by 1950.

R. O. T. C. (drilling frosh): "Attention! Stand erect! Let your legs hang down!"

Highway Division in 1940 Put 200 Road Contracts Under Way in 54 Counties

By GEORGE T. McCOY, Assistant State Highway Engineer

DURING 1940, maintenance expenditures and the cost of construction projects initiated by the California Division of Highways amounted to a total of $39,034,800. Of this sum, $28,572,600 is the cost of the construction work placed under way during the calendar year.

To finance these construction projects, State funds derived from motor fuel taxes and vehicle fees were available in the amount of $20,056,300, reimbursements from Federal funds allocated to California are anticipated totaling $8,446,700, and county funds amounting to $69,600 were provided to match Federal funds on projects off the State Highway System. Approximately 30 per cent of the year's construction program was financed by Federal funds.

SOURCES OF FUNDS

Segregation of the amounts making up the total for construction to the various funds is shown in the following tabulation:

Funds	Amount
Regular Federal Aid	$6,336,700
Secondary or Feeder Road, Federal Aid	581,100
Grade Crossing Elimination, Federal Aid	870,500
Emergency Relief Federal Aid (Storm Damage Repair)	307,300
U. S. Bureau of Reclamation (Highway Relocation at Shasta Dam Reservoir)	351,100
County Funds	69,600
State Highway Fund	20,056,300
Total	$28,572,600

In the foregoing tabulation the State highway funds include appropriations from revenues received by the Division of Highways from the gasoline and Diesel oil taxes and motor vehicle fees for construction, minor improvements, betterments and State contracts financed from one-fourth cent funds allocated to cities.

The total amount of construction and maintenance work undertaken between January 1 and December 31, 1940, was segregated by classification as follows:

Construction	$23,631,100
Maintenance	10,462,200
Engineering	2,916,800
Right of Way	1,974,700
Total	$39,034,800

Progress of construction activities of the State Highway System as gauged by the $18,046,900 of contracts awarded during the year covering 715 miles of highway and 113 bridges and grade separations is shown in the following tabulation:

Type	Miles	Amount
Portland Cement and Asphalt Concrete Pavement	58	$3,956,100
Bituminous Treated Crushed Rock Surfacing	235	5,507,300
Bituminous Surface Treatment Oiled Gravel, and Oiled Earth	106	1,527,700
Armor Coat Retread Surfacing and Seal Coat	241	224,300
Grading and Shoulder Improvement	75	1,835,000
Bridges and Grade Separations	(113)	4,592,800
Miscellaneous Construction		403,700
Totals	715	$18,046,900

200 CONTRACT AWARDS

Contract awards numbering approximately 200 were made during 1940 for construction projects in 54 of the State's 58 counties.

The following condensed data provide a brief review of the new work placed under way on the more heavily traveled trunk-line routes.

Thirteen contracts totaling $2,107,000 provided for the construction of 18 miles of road, three bridges and a viaduct on the Redwood Highway between San Francisco and the Oregon line. Included in these contracts were two bridges across the Eel River in Humboldt County costing $455,000 and $330,000, and the 2,200-foot viaduct through San Rafael costing $381,000. The latter contracts are under construction.

Between Sacramento and Los Angeles on U. S. Route 99, eight contracts totaling $953,000 were awarded for 21 miles of four-lane divided high way construction and five bridges. The largest of these was for grading six miles of the Ridge Route between Fort Tejon and Grapevine Station, and amounted to $385,600.

SHASTA RESERVOIR RELOCATION

North of Sacramento on the Pacific Highway work was put under way on 18 miles of road and three bridges. The nine contracts on this route totaled $852,200, the largest being for grading of the eight-mile section from O'Brien Summit to Antler, as a portion of the relocation at Shasta Dam Reservoir, which amounted to $356,300.

Thirty-two miles of highway, four bridges and an underpass were provided for by award of 17 contracts totaling $1,865,000 on the Coast Route, U. S. 101, between San Francisco and San Diego.

Expenditure of $794,000 was involved in the four contracts for improving 29 miles of State Highway 26, which connects Los Angeles and El Centro. Further improvement of the travel facilities between the coast cities and the Imperial Valley was also provided by a contract for $367,900 covering construction of 3.6 miles on U. S. Route 80 in Imperial County from Mountain Springs easterly.

DAVIS-DIXON REALIGNMENT

Progress toward the ultimate development of a through four-lane highway between Sacramento and the Bay Area was accomplished by the award of seven contracts totaling $798,700 on this route. These contracts included seven miles of new realignment grading from north of Dixon to near Davis, six new bridges, an underpass south of Davis, and the redecking of the Yolo Causeway.

(Continued on page 27)

Grapevine Grade Sliding Hill to Be Stopped by Buttress Fill and Drains

By E. T. SCOTT, District Engineer

WHEN the first correction of the old tortuous Ridge Route section of U. S. 99 in Los Angeles County was broken through in 1933 with the opening of the twenty-seven miles between Castaic and Gorman, the average daily traffic over this main link between the San Joaquin Valley and Southern California was 2,500 cars and trucks per day.

Today with all of the 115 miles of this route paved to three- and four-lane width between Los Angeles and Bakersfield in Kern County, the average daily traffic is nearly six thousand machines of which about 20% are trucks and trailers.

This average is increased on occasions by many special events such as football games and fiestas, reaching the maximum twenty-four hour count of over twenty thousand machines during the unusual display of wildflowers in the San Joaquin Valley in 1939.

The combination of the high percentage of large slow-moving trucks with fast passenger vehicles on this mountain road which rises from sea level up to four thousand feet in elevation and then drops down again, has developed an exceedingly serious traffic problem which makes additional lanes and further separation of traffic imperative.

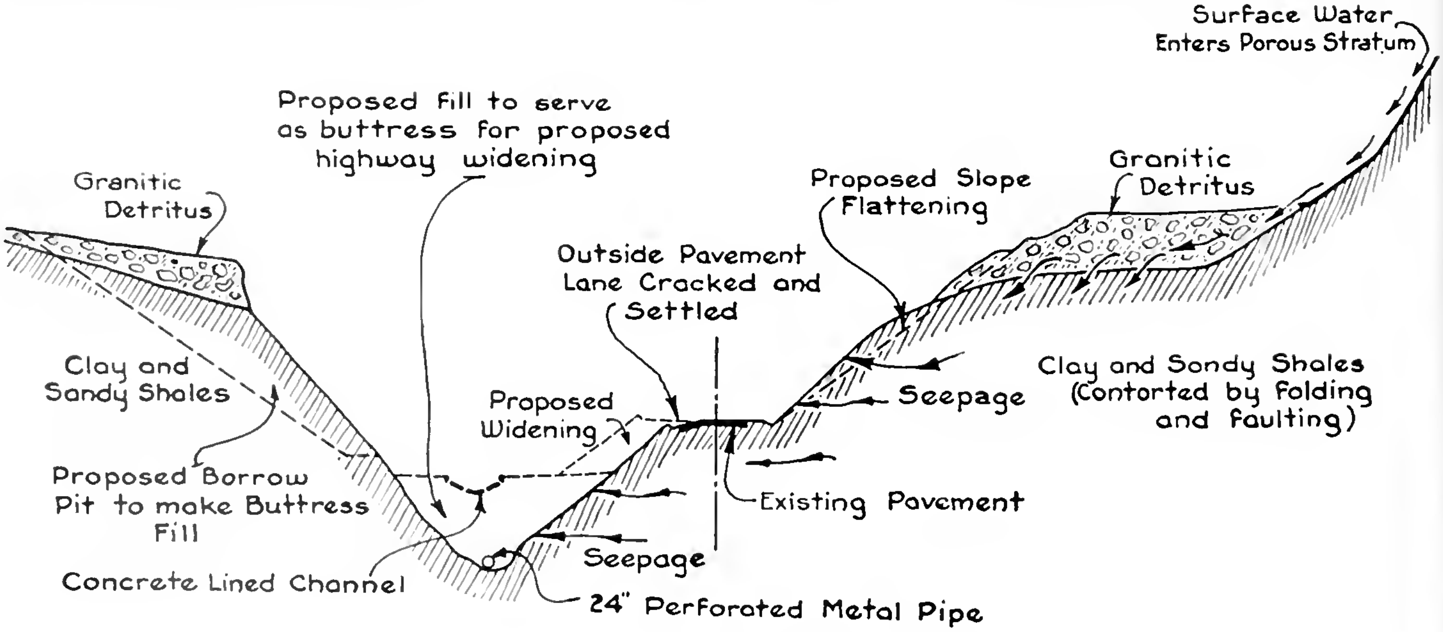
Accident records show the worst section to be through the Grapevine Creek canyon from Old Fort Tejon northerly in Kern County where there is nearly six miles of continuous 5.5% grade down the hill.

In addition to the traffic problems, this portion of the highway has several serious slide areas which are a constant menace to traffic and require regular maintenance expenditures. One badly saturated hillside on which the roadway is carried on a grade below a large oil line pumping plant has been slowly settling towards the canyon of Grapevine Creek and the movement threatens to take out the highway.

FIRST CONTRACT AWARDED

As the first step in meeting this situation, the Director of Public Works on December 20, 1940, awarded to the Griffith Company of Los Angeles a three hundred and eighty-five thousand dollar contract for grading through the six miles of Grapevine Canyon. The work of this contract not only includes the construction of a grade wide enough for a four-lane divided highway but also correction of the areas where slides are giving trouble.

The hillsides above the road that have been moving are to be drained and flattened back to stable slopes and the material from them will be used in widening the roadway embankments. The saturated hillside is to be treated by extensive drainage work in the wet areas above the roadway and by the construction of a buttress fill of over 180,000 cubic yards.



Sketch showing plan for proposed buttress fill and highway widening on Grapevine Canyon

(Continued on page 26)

On upper left photograph of Grapevine Canyon the white lines indicate proposed fill construction and highway widening. Pictures on right show cracked and sliding hillside. In lower left, truck units pulling around slide

North Sacramento Viaduct Will Carry 4-Lane Divided Highway

By JAMES GALLAGHER, Assistant Bridge Engineer

THE California Highway Commission has set up in the budget the necessary funds, plans are being prepared and as soon as the funds become available construction can start on the new four-lane viaduct across the American River Flood Control project across the American River overflow area on Del Paso Boulevard (U. S. 40) between Sacramento and North Sacramento.

The present ground-level road extending from the north end of the 16th Street Bridge over the American River to North Sacramento is inadequate to carry the 20,000 to 25,000 cars which daily pass over this highway.

This ground-level road passes under the tracks of the Sacramento Northern and the Western Pacific. The two subways and the section of road between them are flooded whenever the American and Sacramento Rivers reach an elevation of approximately 28 on the Sacramento River gauge U. S. E. D. datum.

During six of the past twelve seasons it has been necessary to close the road because of high water; ordinarily only for a few days in any one season. In the winter of 1937-1938 the road was closed for a total of fifteen days. In '39 and '40 season it was closed for a total of ten days. In '39 and '40 the road was closed continuously for six days.

When this road is closed, traffic is detoured by way of the Jibboom Street Bridge at the mouth of the American River and about three miles along a narrow levee road and back into North Sacramento over Arcade Creek Bridge.

This route is about three miles longer, but since traffic must travel very slowly along the narrow levee road during the rush hours of morning and evening when traffic is heaviest, this detour adds from 30 to 60 minutes to the time required to travel from North Sacramento to Sacramento.

Another detour is by way of the H Street Bridge over the American River, which route, although not so congested, is about 8 miles longer. During periods of extreme high water the H Street Road is also flooded and forced to be closed to traffic.

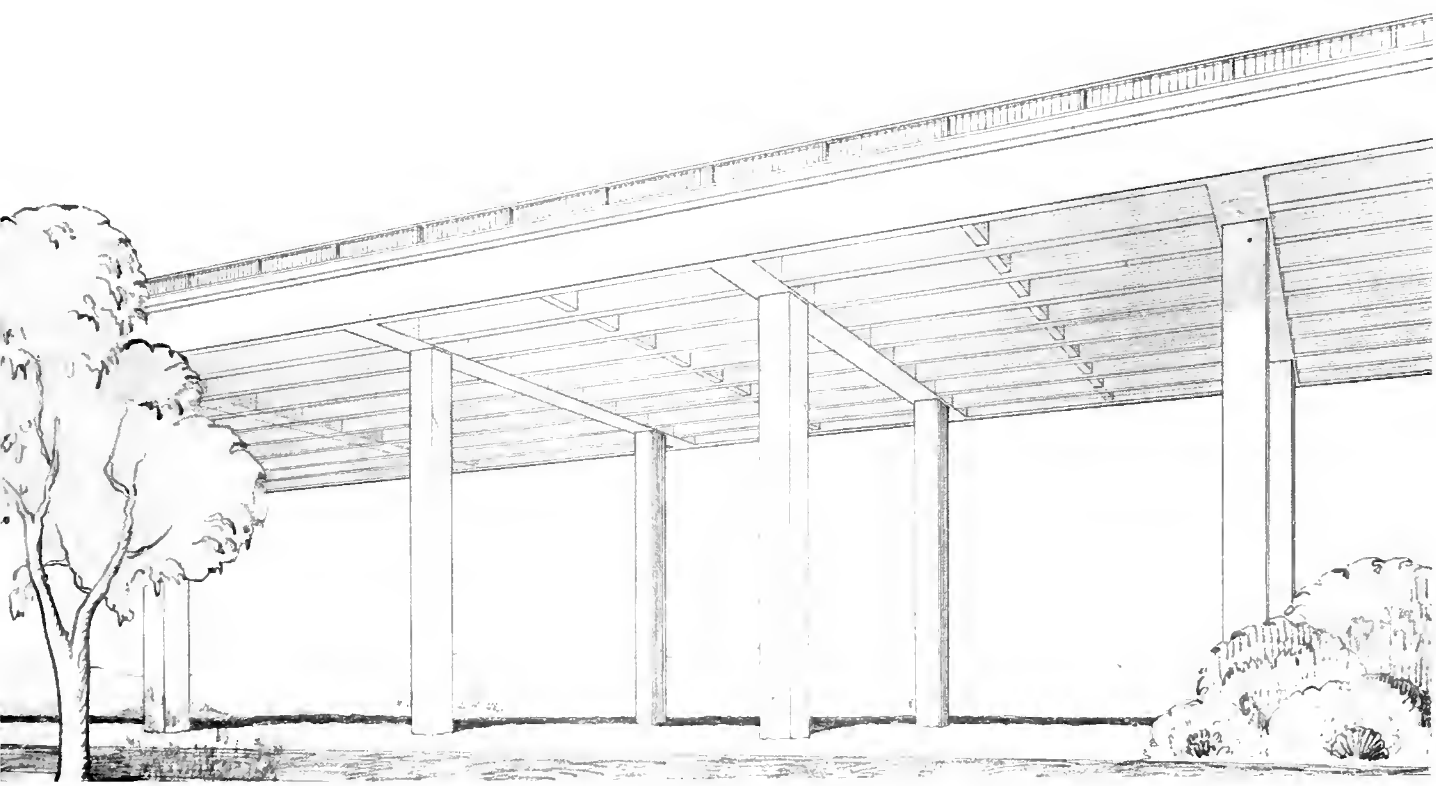
The existing ground-level road and the subways under the two railroads were constructed in 1925 and

Del Paso Boulevard on U. S. 40 between Sacramento and North Sacramento that is flooded at high water periods of American River

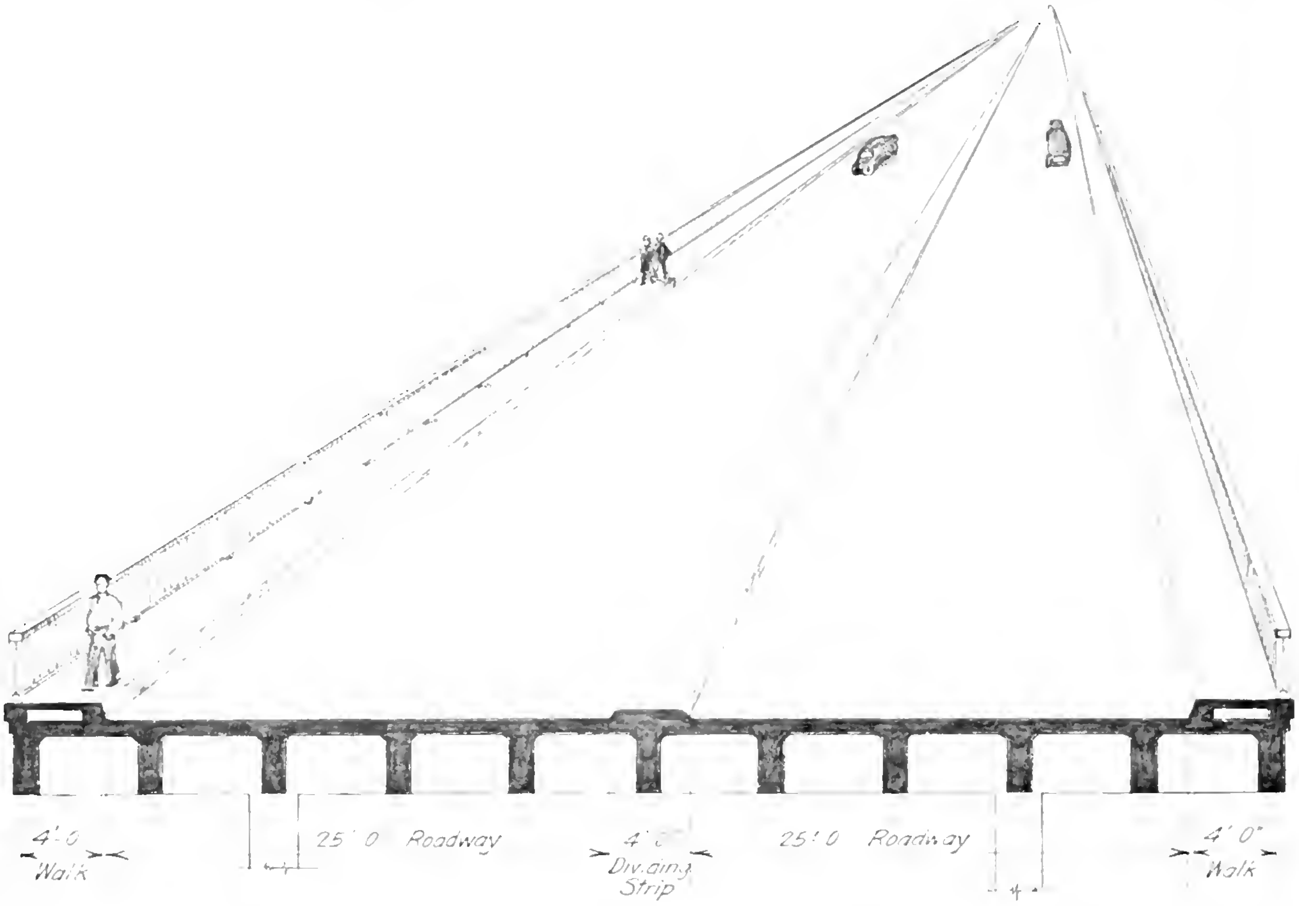
View of Del Paso Boulevard section flooded by overflow waters of American River and closed to traffic

provide for three lanes of traffic. They replace an old narrow timber trestle which crossed the overflow area and intersected the two railroad trestles at two very dangerous grade crossings.

At the time it was replaced this old trestle, on account of its narrow width with two grade crossings, was entirely inadequate to handle the then existing traffic. It was also in a very dangerous structural con-



Sketch of proposed viaduct that will carry a four-lane divided highway section of U. S. 40 across American River overflow



Perspective sketch of 4-lane divided roadway with two 4-foot sidewalks for North Sacramento viaduct

dition and required constant attention and expense to prevent failure under traffic.

Prior to the construction of the ground-level road, studies were made for an overhead viaduct, passing over both of the railroad trestles. Such a viaduct was estimated at that time to cost between five and six times the cost of the ground-level road with the subways.

Although it was then realized that the construction of a viaduct was the only complete solution to eliminate both the grade crossings and the flood menace; nevertheless, on account of the lack of highway funds at that time, it was necessary to proceed with the cheaper ground-level road which would adequately take care of the then existing traffic, except for the few days every other year or so when the highway was flooded.

In 1932 a levee was built along the north side of the American River Flood channel to confine the overflow to a definite channel. This levee crosses the highway about 1700 feet northeast of the American River Bridge. This levee protects a portion of North Sacramento from inundation during periods of extreme high water such as occurred in 1928. Where the highway passes through this levee, the Division of Highways in the fall of 1932 constructed flood gates to be closed when the highway was flooded, to prevent the flood waters from flowing through the highway gap in the levee.

The American River Food Control project is based on a discharge of 180,000 second feet. This is about 25% greater than the discharge for the 1928 flood, as estimated by the U. S. Geological Survey. The project flood plane is 36.1 California Highway Commission datum where the channel crosses the highway. The levees provide about four feet of freeboard above the flood plane. The maximum river stage of record was 32.4 in March, 1928, before the construction of the levee. If the levee had existed, the stage would have been about three feet higher. The peak stage in December, 1937, was 30.6.

The American River channel is about 2400 feet wide between levees. The Sixteenth Street Bridge is 620 feet long across the main channel, which is along the south levee. The proposed viaduct will cross 1700 feet of overflow channel north of that bridge.

The elevation of the existing highway pavement between the railroad subways is elevation 25 C. H. C. datum or 28.7 U. S. E. D. and corresponds to the river stage which requires the closing of the road. However, by placing sand bags along the road between the grade separations, it is possible to keep the road open until the stage is one to two feet higher than this.

The present highway grade, therefore, is about 11 feet below the

(Continued on page 28)

Close-up view of two of the rotary snow plows engaged in widening operations in the Donner Summit area

Snow Removal on State Highway

ALTHOUGH snowfall in California is confined almost entirely to the mountain regions, snow removal is a routine winter task on approximately 3,400 miles of State highways. However, only the more heavily traveled interstate connections and certain important recreational roads are maintained as all-year routes, the balance of the roads being closed with the first heavy snowfall.

The date for the reopening of these roads depends upon the severity of the winter but the policy is to open them for traffic as early as practicable in the spring. The roads over the high passes of the Sierra Nevada Mountains may not be open for summer travel until May or June. Tioga Pass, which reaches an elevation of 9,941 feet, is frequently not opened for summer travel until July.

Donner Highway, U. S. 40, crosses Donner Summit at an elevation of 7,130 feet. This is the main transcontinental route between northern California and the East, and this highway is kept open to all-year traffic under extremely severe winter conditions.

598 INCHES MAXIMUM FALL

The records of the United States Government Weather Station near Soda Springs shows the snowfall in inches at that point during the past six years to have been as follows:

1934-35	498 inches
1935-36	455 inches
1936-37	447 inches
1937-38	598 inches
1938-39	286 inches
1939-40	414 inches

So far this season, up to January 30, 1941, the snowfall at this point has been 252 inches. The picture on the cover of this issue illustrates two three-auger rotary plows at work in widening U. S. 40 just west of Donner Summit. Rotary type plows are indispensible in deep snow and for widening out after the first cut is made.

The job of maintaining the Red Bluff-Susanville lateral, State Sign Route 36, as an all-year route is second in magnitude only to U. S. 40. This route crosses Morgan Summit at an elevation of 5,713 feet, and Fredonyer Summit at 5,748 feet.

The snowfall on Morgan Summit is comparable to Donner, the pack on the ground at this point being 104 inches on January 30, 1941. Although Fredonyer is higher than Morgan, the snowfall is considerably less. It is difficult to see why this should be, but weather conditions present many inconsistencies.

18 FEET AT LASSEN

The point of greatest snowfall on the California State Highway System is on State Sign Route 89 at the

(Continued on page 25)

Ten Bridges Required for Davis-Dixon Realignment

THE work of realigning U. S. 40 in Solano and Yolo counties from a point about 1.3 miles north of Dixon to about 1.0 mile east of Davis is now well under way. The original grading contract for this 7.3 miles of new highway has been completed by Fredrickson Brothers, the general contractor.

Construction of the new subway under the Southern Pacific Railroad about 0.7 mile southwest of Davis by general contractor Heafey-Moore and Fredrickson and Watson Construction Company is approximately 75 per cent completed, and the work of constructing six bridges by general contractor E. T. Lesure across Putah Creek, the South Fork of Putah Creek and Overflows is well under way.

SAVES 3.25 MILES

The project consists, in general, of an urgently needed realignment of a portion of the principal cross-state highway in Northern California. This highway runs from the San Francisco Bay Area, through Sacramento and continues east to the Nevada State line. In common with many of the earlier highways, the existing highway in the vicinity of this new project more or less follows section lines.

The new project will cut diagonally across sections, thereby saving 3.25 miles of distance and reducing the curvature from approximately 612 degrees to about 144 degrees.

The first five miles of this project from Dixon toward Sacramento have been graded for two lanes of traffic with provision for the ultimate development of a four-lane divided highway. The remainder of the project is being constructed to four-lane divided highway standards. It is now planned to make the entire project a four-lane divided highway throughout.

FOUR COMPANION BRIDGES

To provide the additional two lanes on that portion of the project now graded for two lanes, companion bridges will be required at the South Fork of Putah Creek and at the three Putah Creek Overflows. These four bridges are located between Dixon and the new railroad separation structure, and will be built parallel and adjacent to the two-lane bridges now under construction.

All companion bridges are separated a distance of 28 feet between inside gutter lines, and approach roadways are separated by a 32-foot dividing strip.

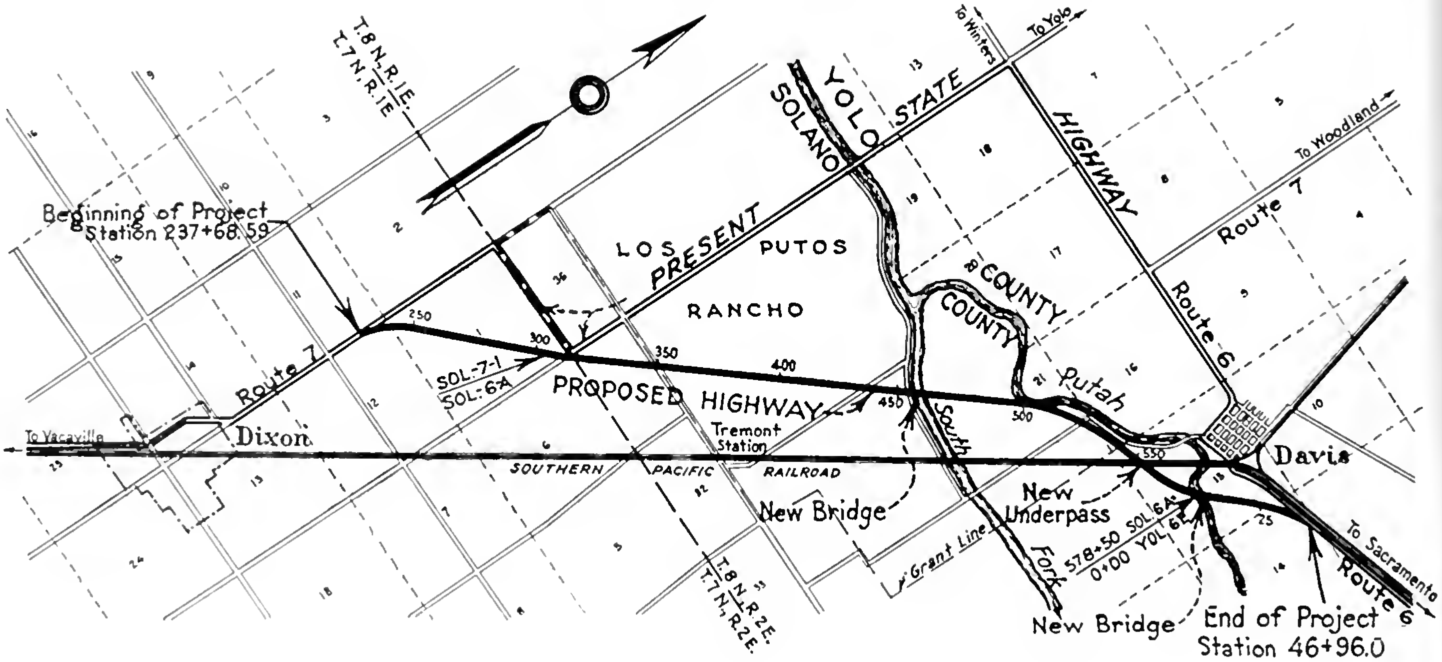
TEN BRIDGES REQUIRED

The two bridges at Putah Creek will be 210 feet long, the two at the South Fork of Putah Creek will each be 478 feet long. The six at the Putah Creek overflows will each be 52 feet 6 inches in length.

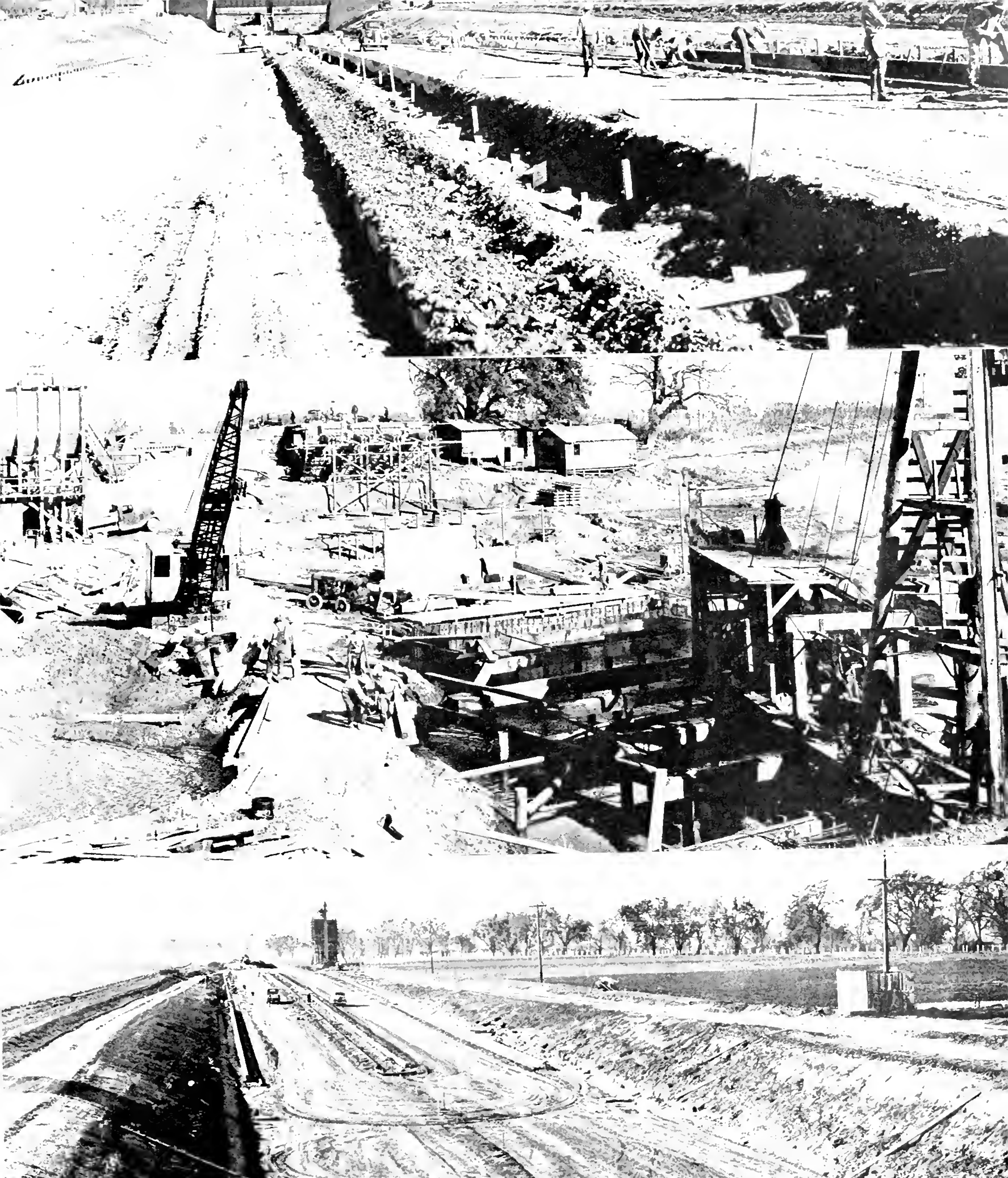
All bridges will be of reinforced concrete construction and will each provide a 27-foot roadway with two narrow walkways.

The new subway consists of a steel and concrete structure designed for two 27-foot roadways with a six-foot dividing strip and two four-foot sidewalks. The cost of the subway will be approximately $190,000.

The accompanying photographs show progress of the work at the subway and at the South Fork of Putah Creek.



Sketch map of realignment of State Highway Route 6 (U. S. 40) between Davis and Dixon



Progress of construction on the realignment of U. S. 40 between Davis and Dixon is shown in the above pictures. At top—Graded section approaching newly completed subway under tracks of Southern Pacific near Davis. Center—Building companion bridges across Putah Creek. At bottom—Grading operations for four traffic lanes and division strip

California Finds Cause of Cement Concrete Failure

THE DECEMBER 1940 Proceedings of the American Society of Civil Engineers contain a paper descriptive of a notable piece of research work successfully carried out during the last two years by the Materials and Research Department of the California Division of Highways on the causes of the excessive expansion and disintegration of portland cement concrete in certain sections of the State.

Not only was the cause of the trouble ascertained, thus solving a problem which has mystified engineers for the last twenty years, but specifications and test procedure have been set up which will insure against similar failures in the future, thereby saving the State hundreds of thousands of dollars over a period of years; a saving many times the cost of the investigation.

The conclusions from the study with substantiating evidence that the excessive expansion was due to a chemical reaction between the cement and certain types of minerals in the rock and sand has attracted national attention.

Checking the work done by this department, the United States Bureau of Reclamation has since definitely traced some of the concrete troubles of that agency to a similar cause.

The implications are so broad and far reaching as to cause concern that similar conditions may be the occasion of other hitherto unexplained concrete troubles, and in this connection the bureau is proposing to submit for the consideration of the cement industry in the western States a comprehensive program of cooperative research.

WESTERN HEMISPHERE TRAVEL INCREASES

Travel increases between the United States and other areas in the Western Hemisphere ranged from 12 to 18 per cent in the first half of 1940 as compared with the same period in 1938 according to a report made to Secretary of the Interior Harold L. Ickes by W. Bruce MacNamee, chief of the United States Travel Bureau.

1,646,659 Vehicles Used Three State Toll Bridges in January

IN SPITE of continued wet and stormy weather throughout the month, the January traffic on the San Francisco-Oakland Bay Bridge held up well. On January 1, 1941, 69,077 vehicles crossed the bridge making this the heaviest day since its opening on November 12, 1936. The total for the month was 1,369,871 vehicles, representing an increase of 61% over January, 1940.

This growth in traffic is attributable in part to the two toll reductions made effective during 1940, to the final abandonment of the automobile ferry service between San Francisco and Oakland, and to the general increases in traffic which have been particularly noticeable in areas where National defense activities are under way.

The Carquinez Bridge, with a total of 265,422 vehicles for the month, showed an even greater proportionate increase over the same month of the previous year. The principal contributing causes in this case appear to be the toll reduction put into effect with State operation and the greatly accelerated construction program at Mare Island Navy Yard.

Traffic for January on the San Francisco-Oakland Bay Bridge and the Carquinez and Antioch bridges is tabulated below:

	San Francisco-Oakland Bay Bridge	Carquinez Bridge	Antioch Bridge
Passenger autos and auto trailers	1,254,602	241,413	9,462
Motorcycles and tricars	2,753	404	15
Buses	21,398	4,519	188
Trucks and truck trailers	67,235	18,894	1,695
Others	23,883	192	6
Total vehicles	1,369,871	265,422	11,366

Grapevine Grade Sliding Hill to be Stopped

(Continued from page 18)

This mass of earth will completely fill the narrow canyon of Grapevine Creek to a depth of about forty feet through the section where hillside movements are occurring. To prevent the possibility of the creek cutting out this fill, a concrete lined channel with a special spillway at its lower end will be constructed for a distance of nearly two thousand feet, requiring the use of some 3,800 cubic yards of reinforced concrete.

The fill will not only act to brace the moving hillside against the opposite side of the canyon but will also act as a counterweight to balance the earth pressures which now tend to heave or lift the stream bed.

WILL MAINTAIN TRAFFIC

Traffic will be maintained through the work at all times and the construction is to be so handled as to give the least possible interference to the convenience of the traveling public. Three hundred working days are allowed for completion of the contract.

The work of widening the present three-lane pavement to a four-lane divided highway will be handled under a contract to be let after the present project has been completed. Funds for this purpose are provided in the budget for the coming biennium.

Federal Defense Road Program

(Continued from page 7)

two-year period and 25 per cent less than for the fiscal years ending June 30, 1938 and 1939.

If improvement to the designated access, industrial and strategic roads is to be accomplished within a reasonable time without complete disruption of normal State highway development, additional Federal appropriations must be made by the Congress to finance defense road construction and provisions made for the administration of such appropriations by the Federal agencies which handle regular Federal aid to the States for highway construction.

200 Road Contracts Put Under Way in 54 Counties in 1940

[illegible]

Five contracts for [illegible] structures to accommodate cross traffic [illegible] the completion of the Arroyo Seco Parkway between Los Angeles and Pasadena and permitted the [illegible] of [illegible] $7,000,000 pr[illegible] residents of this congested area.

[illegible] ROAD CONTRACTS

In cooperation with the counties of Fresno, Modoc, San Diego, Santa Clara and Siskiyou, seven contracts totaling $150,000 were awarded for constructing 22 miles of roads, three bridges and a railroad [illegible] pass on roads off the State Highway system. These projects were financed entirely by Federal secondary highway and county funds.

On January 1, 1941, the Division of Highways entered the final quarter of the current biennial period with only about 37 major budgeted projects estimated to cost $3,040,000 remaining to be placed under way before July 1 of this year, the beginning of the [illegible] biennium.

This favorable condition places the Division of Highways in a position to begin the preparation of plans and specifications on major projects included in the proposed budget for the coming biennium estimated to cost $48,615,000 as soon as the State Legislature adopts the budget.

Federal aid allocations to California to help finance the proposed construction program are estimated to amount to $7,600,000 for the two-year period.

For Future Publication

Publication of the article describing activities and functions of the Department of Public Works announced to appear in this issue has been postponed owing to unavoidable delay in its preparation.

This feature will be published, however, in response to numerous requests in a future issue.

ATTENTION, PAINTERS!

Wife (rousing husband): "I believe a burglar's trying to open the drawing room window."

Husband: "Good. I haven't been able to move it since the painter was here."

Highway Bids and Awards for January, 1941

FRESNO COUNTY [illegible]

IMPERIAL COUNTY [illegible]

INYO COUNTY [illegible]

KERN COUNTY [illegible]

LOS ANGELES COUNTY [illegible]

LOS ANGELES COUNTY [illegible]

LOS ANGELES COUNTY [illegible]

NAPA COUNTY [illegible]

[illegible]

RIVERSIDE COUNTY [illegible]

SACRAMENTO-SAN JOAQUIN COUNTIES [illegible]

SAN DIEGO COUNTY [illegible]

SAN MATEO COUNTY [illegible]

SONOMA COUNTY [illegible]

North Sacramento Viaduct Plans

(Continued from page 22)

adopted flood plane and 7.4 feet below the 1928 flood stage. Since the highway is crossing an overflow channel, the Flood Control District and the State Reclamation Board would not permit construction of high levees to protect the highway, since such construction would raise the level of the flood waters and endanger the main levees with consequent flooding of adjacent area.

The alignment for the new structure going north from the Sixteenth Street Bridge deflects slightly to the right and crosses the north levee about 300 feet from the existing road. This permits the use of the present highway without interference during the construction of the viaduct except at the south end. The viaduct structure will start about 300 feet north of the north end of the bridge, will be 1496 feet long, consisting of 36 spans of 41 feet with a 10-foot cantilever span at each end.

FOUR-LANE HIGHWAY

The viaduct will have a 4-lane divided highway, two 25-foot roadways with a 4-foot dividing strip between, plus two 4-foot sidewalks. It will be a continuous reinforced concrete structure supported on two post reinforced concrete bents on pile foundations, since the soft silt and clay soil found near the surface is not suited to spread footings. There will be a total of five expansion joints in the length of the structure.

Profile grade over the new structure is controlled by the elevation of the existing bridge, the required vertical clearance over the two railroads and the desired sight distance over the crown.

A vertical curve 1050 feet long is to be used connecting approach grades, which are 6.2 per cent at the point where they intercept the inverted vertical curves running off on the approaches. At the point of maximum height, the new viaduct will be slightly more than 50 feet above the ground.

Where the viaduct crosses the railroad trestles, it is necessary to provide sufficient clearance above the railroad tracks to permit the future raising of the railroad trestles to place the clearance line of these trestles three feet above the flood plane. This will require about a 2-foot raise of the Sacramento Northern trestle and a 6-foot raise of the Western Pacific trestle.

28-FOOT CLEARANCE

To provide for this raise in addition to the clearance over a railroad track required by the Railroad Commission the under side of the deck of the highway structure will be 28 feet above the present railroad trestle.

The north end of the viaduct will extend about 100 feet beyond the north levee where it will intersect the approach fill. The maximum height of the approach fill will be about 35 feet. From the north end of the viaduct the approach ramp will curve to the left and intersect the existing road at ground-level about 1600 feet north of the levee.

DETOUR ROADS NECESSARY

The construction of the southerly 250 feet of the new viaduct will interfere with traffic on the existing highway and will require the surfacing of short detour roads around the construction. These detour roads will serve as approach roads to the Garden Highway connection after the new viaduct has been completed.

Traffic from Sacramento for the Garden Highway will be carried under the new viaduct after crossing the Sixteenth Street Bridge without the necessity of crossing south-bound traffic.

As required by law, the plans for this structure over the overflow channel were submitted to the State Reclamation Board and were approved by that Board at their meeting on January 15. Plans will also be submitted to the State Railroad Commission since the structure involves an overhead over two railroads.

Detailed contract plans and specifications are now nearing completion and will be ready for advertising as soon as funds are available. Construction will take about one year after the contract has been awarded.

In Memoriam

James McCulloch Call

March 19, 1900–January 21, 1941

The untimely death of Jim Call on January 21, 1941, was a distinct shock to his host of friends and fellow workers in the Department of Public Works and the Division of Highways. Through his passing, the Division has lost a valuable and conscientious employee who rose through the ranks during eighteen years of loyal service to the responsible position of Supervising Outdoor Advertising Inspector in the Headquarters Maintenance Department.

Jim's kind and unselfish nature endeared him to all his associates, who will always remember his friendly disposition and willingness to lend a helping hand. He was widely known throughout the organization, having worked in the district offices of Districts III, VI, IX and X, with contacts in all the other Districts in his capacity as Supervising Outdoor Advertising Inspector.

The sudden ending of his successful career was a severe blow and great loss to his widow, Mrs. Ruby Call, and three weeks old daughter, Sharon. To Mrs. Call and her daughter is extended the deepest sympathy of all Jim's friends and employees of the Department of Public Works.

Snow Removal On Highways

(Continued from page 23)

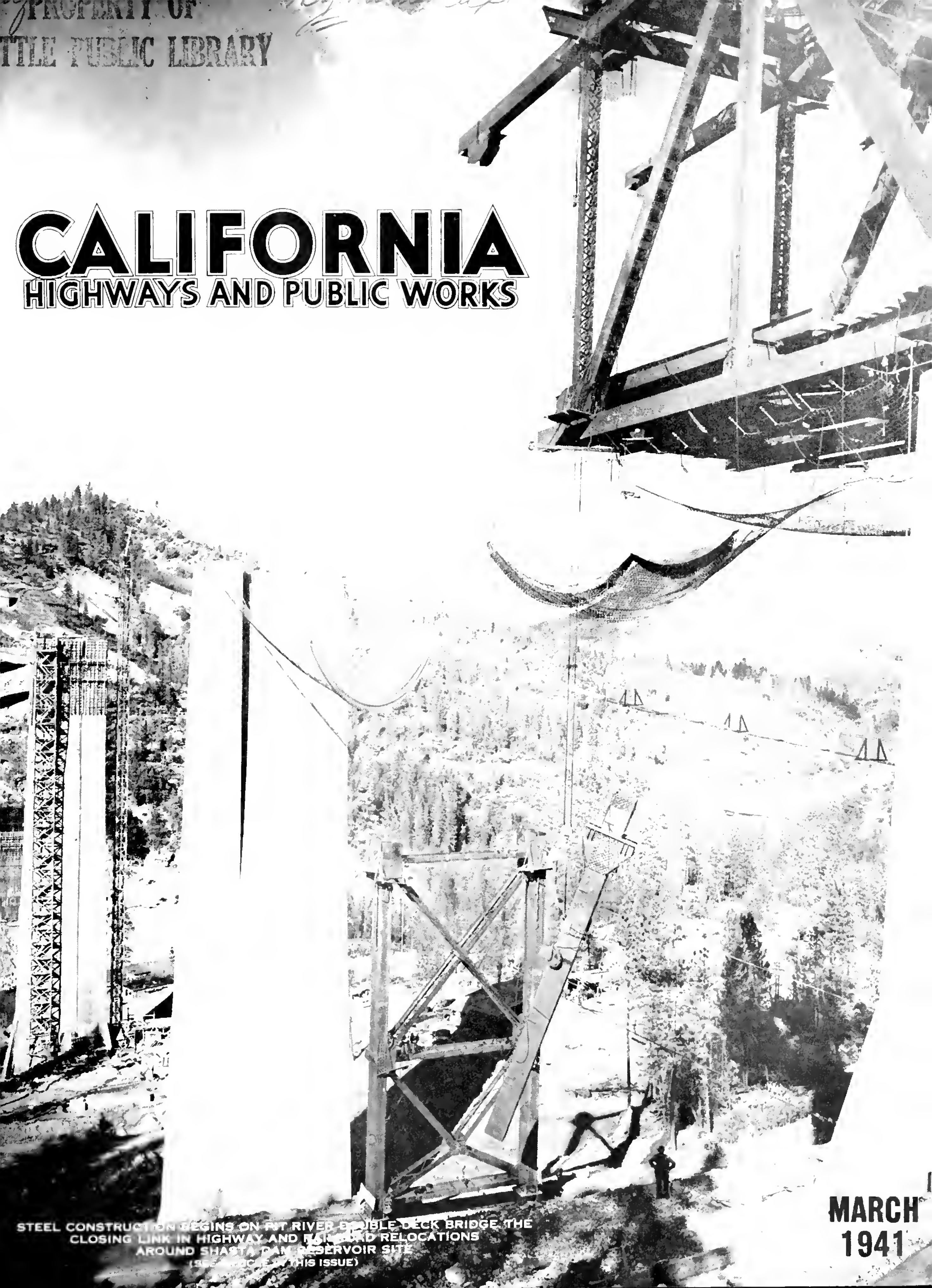
south entrance of Lassen National Park, where, as of this date, the snow pack is 16 feet in depth.

The usual procedure for maintaining an open road through snow country consists of removing the snow as it falls, the work being carried on continuously for the duration of the storm when necessary to keep traffic moving. In territory where only an occasional light fall of snow occurs, the regular maintenance equipment may be sufficient to keep the road open, or this may be supplemented by trucks equipped with push plows.

In territory where snow removal is routine, heavy four-wheel-drive trucks are provided, equipped either with straight or reversible blades, or V type of blade, or where snowfall is heavy, two- or three-auger rotary type plows are used.

At the present time, the State Division of Highways is operating 30 rotary snow plows. In addition to these, there are also in service 176 blade plows, 41 graders, 15 tractors, and about 195 trucks. This equipment represents an investment by the State of over $1,300,000.

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



STEEL CONSTRUCTION BEGINS ON PIT RIVER DOUBLE DECK BRIDGE THE CLOSING LINK IN HIGHWAY AND RAILROAD RELOCATIONS AROUND SHASTA DAM RESERVOIR SITE

(SEE ARTICLE IN THIS ISSUE)

MARCH
1941

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California

FRANK W. CLARK, Director C. H. PURCELL, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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Vol. 19 MARCH, 1941 No. 3

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Damage to State Highways by February Storms Will Cost $600,000 in Maintenance Funds

By T. H. DENNIS, Maintenance Engineer

STORM damage to California's rural State highways during the month of February totaled $600,000. Two-thirds of this damage occurred in the 13 southern counties, one-third alone being in the Los Angeles district.

The present winter has offered few spectacles of washed-out roads or bridges; however, some 50 days of rain, almost without respite, has so saturated the underlying support of light type pavements that heavy expenditures will be required for their repair.

Damage was widespread, varying from mud flows to major slides of thousands of cubic yards of rock and earth. During February, there was hardly a major route which was not at some time closed for a short period while the maintenance crews labored to clear the highways or provide suitable detours.

Storm Damage to State Highways

District	Headquarters	Amount
I	Eureka	$70,000
II	Redding	50,000
III	Marysville	10,000
IV	San Francisco	35,000
V	San Luis Obispo	160,000
VI	Fresno	30,000
VII	Los Angeles	200,000
VIII	San Bernardino	20,000
IX	Bishop	5,000
X	Stockton	10,000
XI	San Diego	10,000
	Total	$600,000

Many miles of highway were flooded. At locations where the water was not too deep, the highway was outlined with stakes and lanterns, and flagmen placed to warn and slow traffic. On U. S. 99, south of Bakersfield, high velocity windstorms uprooted roadside trees, covered the highway with sand drifts, and so darkened the air that travel became hazardous.

A cloudburst along Willow Creek in Shasta County ripped out six heavy embankments, causing $30,000 in damage and stopping all eastbound traffic from Weaverville.

The coast route west of Santa Monica was covered with mud flows and heavy slides, which in several instances trapped cars and trucks. One major slipout on this same route carried the embankment and pavement into the ocean and closed the highway for hours. Heavy run-off in the Topanga Canyon ate into the highway embankments at several locations, leaving only a trail.

Section of State highway between Redding and Weaverville in Shasta County ripped out by flood waters due to cloudburst

Section of Coast Road (U. S. 101) in Santa Barbara County washed out by flood due to blocked drainage

Blocked drainage on U. S. 101 in Santa Barbara County washed out sections of pavement, which closed the road for a period. These are but a few of the highlights of damage occasioned by the February rains. They fail, however, to mention the innumerable details and physical effort required to clear these highways.

Naturally, it would not be economical for the Division of Highways to own sufficient equipment to immediately clear all highways, as the work is varied and of comparatively short duration. It is therefore necessary to secure competitive bids from private sources for much of the equipment required. The remarkable speed with which repair is undertaken speaks well for the districts' maintenance organizations, as well as the cooperativeness of the equipment contractor.

It is not generally realized that, since 1933, 17½ per cent of all maintenance money has been expended for the repair of storm damage. Since legally these funds can only be spent for restoration, obviously such expenditures do not add to the capital investment in our State highways.

Actually, we often lose a portion of our capital investment, as funds are not always available for complete restoration. There is likewise a certain loss in work efficiency, since it is not always possible to choose the best working conditions if the highways are to be repaired at the earliest possible moment.

It is unlikely that slide expenditures will be reduced in the future in view of the insistent demand for high-speed, direct routings which, to

(Continued on page 27)

Flood waters rushing down Topanga Canyon to coast west of Santa Monica carried away huge sections of State Highway

Two Palo Alto Grade Separations Dedicated With Gala Ceremonies

THE City of Palo Alto and Stanford University joined hands on Saturday morning, March 8,) jointly celebrate the official dedica-on of Palo Alto's two newly com-leted highway underpasses which ave brought a modern solution of 'affic congestion on University Ave-ue and on El Camino Real.

For Stanford University, observ-ig the 50th anniversary of its ounding by Senator, afterwards overnor, Leland Stanford, the occa-on was of particular importance. or Palo Alto the dedicatory cere-onies signalized the fruition of years : planning for highway betterment.

Governor Culbert L. Olson, with ords of praise for the man who had een a predecessor in the guberna-rial office and who gave to Califor-ia one of the world's outstanding stitutions of learning, formally pened the two underpasses to the ublic.

COLORFUL PARADE

Federal, State and city officials par-cipated in the ceremonies and San ose, San Mateo, Burlingame, San rancisco and other peninsula com-unities assisted Palo Alto in staging ie of the most colorful parades ever itnessed in Northern California.

The Southern Pacific Company, hich elevated its railroad tracks rough Palo Alto and erected a new epot in order to make possible the evelopment, contributed its share to e celebration. As the noon stream-ned Southern Pacific Daylight train 1 route from San Francisco to Los ngeles rolled into Palo Alto the icient wood-burning locomotive, the W. Bowker, built in 1875, and haul-g old wooden cars, puffed along on 1 adjacent track, offering a striking ntrast.

The theme of the past and the pres-it was also carried out in the parade which were covered wagons, stage aches, hand-pulled fire apparatus of ie '80s from San Francisco, Palo lto and San Jose, and 37 types of itomobiles of early vintage spaced etween modern motor transportation ehicles, 1941 models of automobiles and up-to-the-minute fire department equipment.

Military units, the American Legion, uniformed outfits of fraternal organizations and drum corps and bands added a picturesque touch to the parade.

Cooperation in Costs

The Federal and State governments, the City of Palo Alto and the Southern Pacific Company participated in the two highway improvement projects.

FEDERAL FEEDER ROAD CONTRACT (Off State System)

University Avenue Under Main Line S. P. R. R. Tracks:

Fed. Grade Crossing Funds (1939)	$223,918	
WPA Grade Crossing Funds	163,263	
S. P. R. R. Funds (curb)	2,389	
	$389,570	$389,570

This contract, awarded to Paul J. Tyler on November 16, 1939, consists of an underpass, reinforced concrete structures, and steel beam track spans under the S. P. R. R.

STATE HIGHWAY CONTRACTS

On El Camino Real Under University Avenue:

(1) Structure—		
Fed. Aid Funds	$18,002	
State Highway Funds	13,038	
¼-Cent City Street Funds (Palo Alto)	19,834	
	$50,874	$50,874

This contract awarded to Earl W. Heple on July 15, 1940, consists of carrying State Highway (El Camino Real) under University Avenue at entrance of Stanford University.

(2) Highway (4-lane pavement divided)—		
Fed. Aid Funds	$21,202	
State Highway Funds	15,353	
¼-Cent State Route Funds	44,578	
¼-Cent City Street Funds	21,100	
	$102,233	$102,233
(3) Landscaping—Bids to be opened March 20, 1940		8,000
Total		$550,677

NOTABLE LIST OF SPEAKERS

Governor Olson and President Ray Lyman Wilbur of Stanford University were the principal speakers among an imposing list of whom were Dr. L. I. Hewes, United States Public Roads Administration; Larry Barrett, chairman of the California Highway Commission; President A. D. McDonald of the Southern Pacific; Dean Samuel B. Morris of the Stanford School of Engineering; Henry S. Lyons, grand president of the Native Sons of California, and Mayor J. Byron Blois of Palo Alto.

The State Department of Public Works was represented by Director Frank W. Clark, Assistant Director Franz B. Sachse, a Stanford graduate, and Deputy Director Morgan Keaton. Col. Jno. H. Skeggs, District Highway Engineer in San Francisco, represented State Highway Engineer C. H. Purcell.

Prof. Edwin A. Cottrell, former mayor of Palo Alto, was master of ceremonies on the speakers' platform. Dr. Augustine Jones delivered the invocation.

MC QUARRIE MURAL UNVEILED

Following the program of speeches, a luncheon was served in the Veterans' Memorial Building, with Governor Olson as guest of honor, after which a mural in the new Southern Pacific depot by John McQuarrie was unveiled. The mural depicts Governor Stanford's dream—the University of Stanford—and the cavalcade of pioneer days and transportation progress in California.

Mounted on a black charger and flanked by Mayor Blois and City Engineer L. Harold Anderson, whose efforts did much to bring about completion of the underpasses, Governor Olson led the parade through the downtown business district, thence through the University Avenue underpass to the El Camino Real underpass and then to the speakers' stand.

Leading the Palo Alto parade, Governor Olson is riding the black horse, with City Engineer L. Harold Anderson at left and Mayor J. Byron Blois at right

Dismounting at the entrance to both underpasses, Governor Olson cut chains of marigold stretched across the roadway, officially throwing the projects open to public use.

In an extemporaneous address which was broadcast Governor Olson took occasion to point out the celebration exemplified the difference between the free and democratic form of government existing in this country which makes possible such cooperative undertakings as the Palo Alto highway projects and the gala observance of their realization and the rule of dictators which impede rather than further the progress of civilization. The Governor said in part:

"All of California is interested in this day of dedication and celebration at Palo Alto. Interested, not merely because we celebrate and dedicate the modern facilities of transportation which are meeting the great needs for public convenience and safety in the underpasses now so splendidly completed with modern construction not that we are merely enjoying and celebrating the completion of a new and modern up to date railroad station but because all of this celebration and dedication typifies and further emphasizes the workings of our American democracy.

"We are also here today celebrating the 50th Anniversary of one of the foremost educational institutions in the United States, an institution of which all the people of the State of California are justly proud.

"Looking backward, we review the fifty years of development and growth of Palo Alto with the growth of that great institution devoted to higher education and scientific research. When we do this and see the people assembled in enthusiastic pride, in peace and in the democratic way of life, this community of Palo Alto and all the adjoining communities, and representatives of State and local governments elsewhere know that this is a classic example of the success of American democracy. * * * That this is the answer to all foreign ideologies for those who cherish the success of American democracy. Here is represented the progress we can and do make through the working of our democratic institutions.

"The developments we are dedicating today, these public improvements, required that cooperation, that spirit or sense of civic responsibility on the part of community leaders and of the people as a whole in order to produce them."

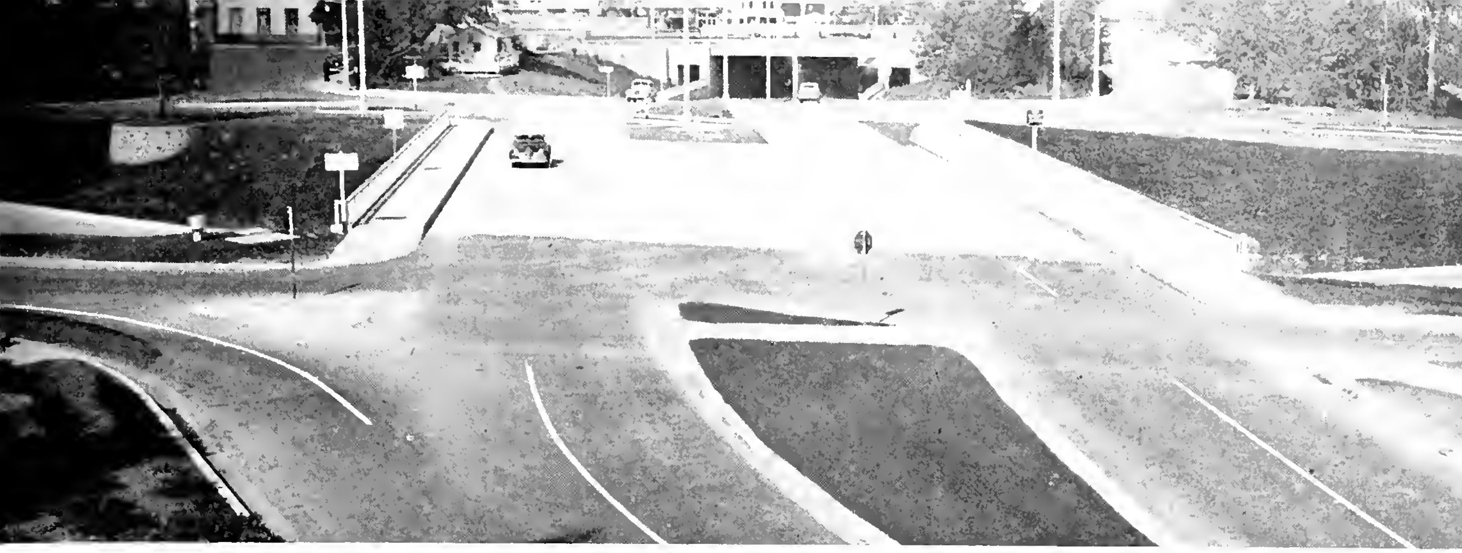
"When we consider this development at Palo Alto—when we look with pride upon it as being one of the classic examples of American life and community interest and cooperation, we can point to more accomplishments than these modern construction conveniences portray. We can point to that cooperation that successful cooperation and accomplishment by the people of Palo Alto for the economic welfare of those who are served by its public utilities.

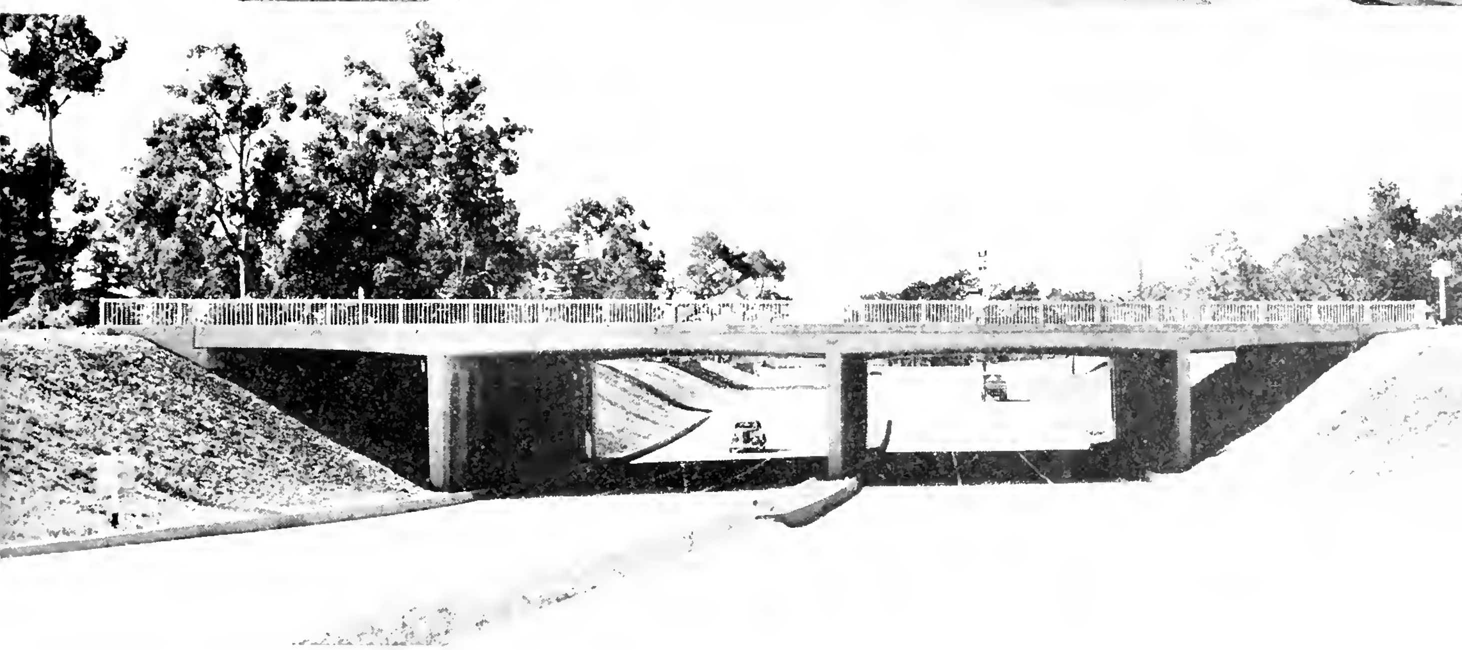
"We have here in Palo Alto public ownership and operation of its public utilities, not only of water—but of power and light and gas which are so essential to modern living. And this has been accomplished against heavy odds and at the cost of long struggle to remove obstacles interposed by narrow private interests.

* * * * *

AN ENDLESS STRUGGLE

"Of course we know that to make such progress requires an everlasting struggle. There is no end to it. But it takes time, tolerance, devotion and sincerity of leadership and social





Top—General view of Palo Alto improvements. Center—University Avenue underpass beneath S. P. railroad. Bottom—El Camino Real (U. S. 101) underpass mindedness in order that we may elsewhere in the State see communities accomplish what Palo Alto has accomplished to better serve the needs and welfare of the people by Government doing the things which Government can do best, and do most economically to advance the general welfare.

"Any philosophy of government that stands in the way of that, we know to be essentially reactionary. We know this because we can point to the progress made here at Palo Alto as the complete answer to all who doubt the efficiency and workability of democracy as a basic principle of government.

"You are particularly benefited and have reason to be happy here in Palo Alto in the birthday of this great university where the molding of the lives of so many of California citizens and leaders in our social, industrial and economic life has taken place—where is given the inspiration for the high ideals so necessary in these days when democracies everywhere are fighting to defend their very existence.

IDEALS OUR STRENGTH

"These ideals are weapons and give us that internal strength which is our greatest buttress against foes of democracy, whether they attack us by military force, or by propaganda, or through fifth columnists seeking to undermine the confidence of our citizens in our democracy.

"We know that we are just as strong internally as the faith of our citizens in our government—just as strong internally as their confidence in the ability not only for our own citizens to preserve their own democratic institutions, but the ability for our nation to supply world leadership toward a higher and higher civilization."

TWO NEW UNDERPASSES

No longer will traffic be delayed on University Avenue, a Palo Alto city street, by the passing and stopping of trains, nor will traffic be held up by traffic lights at the intersection of El Camino Real, U. S. 101 and University Avenue. The two new underpasses under construction but sufficiently completed to permit their use will eliminate all danger to traffic and pedestrians at those points.

During construction of these major structures, traffic has been detoured around the work causing a general but necessary inconvenience to those who had occasion to use these detours.

The structures now opened to traffic are the University Avenue Underpass separating street traffic on this busy avenue from the equally busy railroad traffic on the Southern Pacific's lines and the underpass on El Camino Real separating main highway traffic from that on University Avenue.

University Avenue, in addition to being the main business thoroughfare of Palo Alto, serves as the main route between Palo Alto and Stanford University. Between the city proper and the university, this avenue crosses both the main line tracks of the Southern Pacific Company and U. S. Route 101.

GRADE SEPARATION STRUCTURES

The structure at the railroad crossing carries three tracks of the railroad with provision for a future fourth track. Immediately adjacent to the railroad structure, and on each side of it, are highway structures providing for carrying Alma Street traffic over University Avenue on the north side and a cross-over for University Avenue traffic en route to and from the Southern Pacific station on the south side.

University Avenue through traffic is carried through the underpass on two 25-foot traffic lanes separated by a six-foot dividing strip. The highway structure for Alma Street traffic provides a 45-foot roadway, while the highway structure for station traffic provides a 26-foot, two-lane roadway.

The railroad structure consists of continuous steel beam spans supported on concrete piers and abutments with creosoted timber pile foundations.

The adjacent highway structures are of the same construction as the railroad structure, except that their superstructures consist of continuous concrete slab types. Abutments are of double deck cellular construction with the upper decks used as pedestrian tunnels and the lower decks available as storage space for storm water during extreme rainfall conditions.

RAILROAD SHIFTED TRACKS

In order to carry University Avenue under the railroad tracks it was necessary to shift the tracks approximately 81 feet south of their original position and raise them five feet. This shift required extensive changes in railroad facilities at Palo Alto. In addition to the railroad work done in conjunction with the underpass construction, the Southern Pacific Company has spent in the neighborhood

An Appreciation

1441 Roosevelt Ave.,
Redwood City, Calif.
January 14, 1941.

Governor Culbert L. Olson,
Sacramento, Calif.

Dear Sir:

We, Mrs. Foster and I, wish to express our appreciation of the splendid work being done by the Highway Department.

Last Wednesday we drove to Los Angeles via US 101 and returned Saturday via US 99. For the most part the weather was very stormy and numerous slides, rocks, etc., were encountered. At no time, however, did we find any major hazard not marked by flares or other warning. This was particularly exceptional since most of our driving on both parts of the trip was done at night.

To you, the personnel of the Highway Department and especially the numerous men we saw out in the storm placing the various warning signs, thank you.

Very truly yours,
JOHN W. FOSTER.

State of California
Governor's Office
Sacramento

January 17, 1941.

Mr. John W. Foster,
1441 Roosevelt Avenue,
Redwood City, California

Dear Mr. Foster:

I have your letter of January 14th and wish to express my appreciation for your kind words of commendation for the service of the Division of Highways.

Cordially yours,
CULBERT L. OLSON,
Governor of California.

of $100,000 of its own funds for tation modernization.

State Highway Route 2, or El Camino Real as it is more familiarly known, parallels the railroad tracks n the vicinity of Palo Alto and rosses University Avenue between he railroad and Stanford University. Traffic congestion at this intersection reated the need for a separation of his main through highway down the San Francisco peninsula from University Avenue. To meet that need he underpass structure on El Camino Real and approach roadways were let o contract and are now nearing comletion.

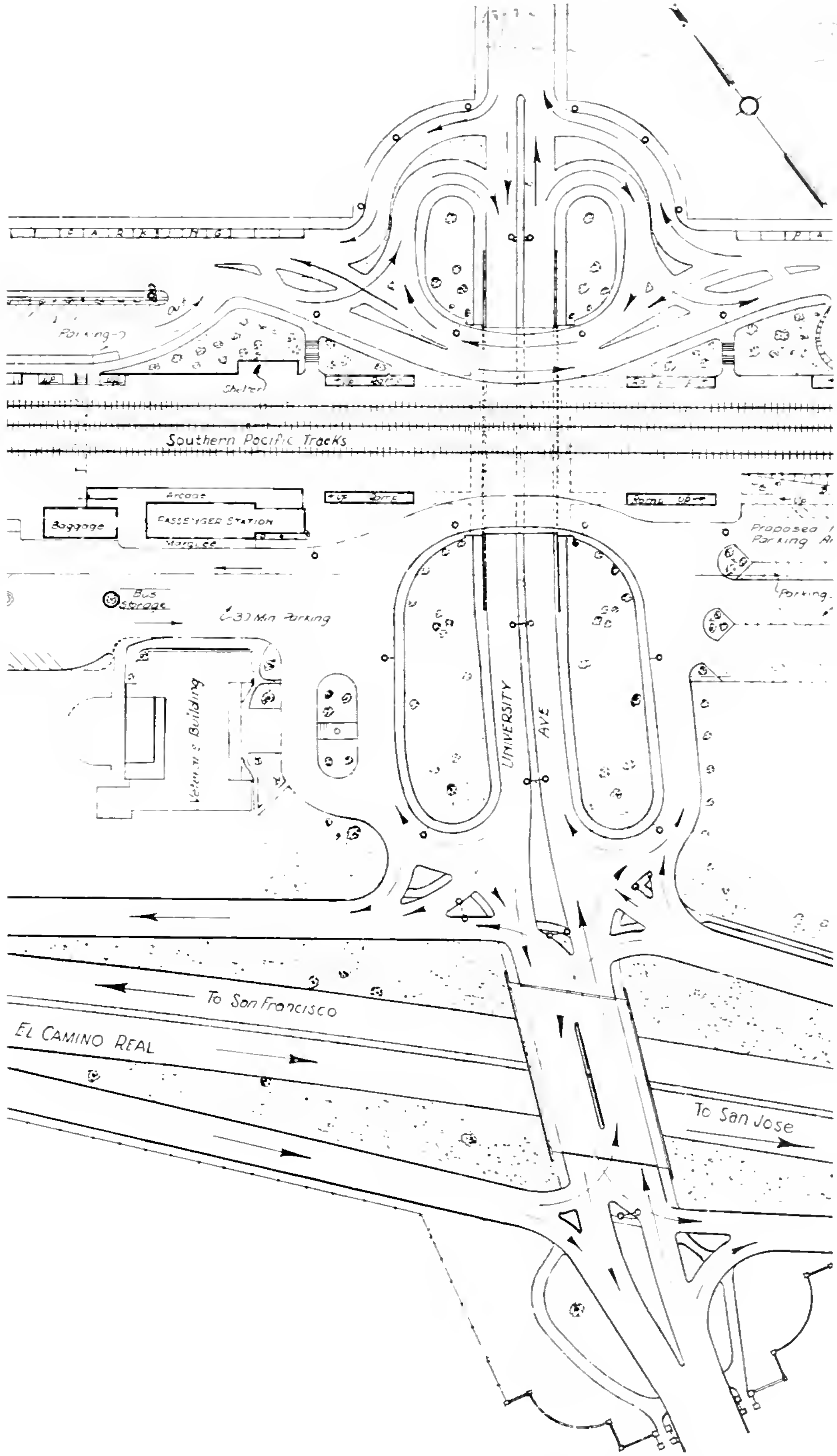
The El Camino Real underpass tructure provides for carrying highway traffic under University Avenue n two 35-foot roadways separated by six-foot dividing strip, and carries University Avenue traffic above on wo 35-foot roadways separated by a our-foot dividing strip. Sidewalks re provided on each side of the oads, those on El Camino Real being our feet wide and those on University Avenue eight feet wide. The tructure is of rigid frame concrete onstruction and is located 550 feet outh of the railroad separation structure. Side roads of semicloverleaf orm connect El Camino Real with University Avenue.

It is estimated that in the neighborood of 600 vehicle minutes per day were lost at the railroad crossing lone due to the passage of approximately 80 trains daily. The loss of his time, together with an unestimated time loss at the El Camino Real-University Avenue intersection, will be saved to the motoring public. n addition to the saving of time, and f much greater importance, is the limination of traffic hazards and the romotion of safety for motorists.

At the present time, the work of urfacing the approach roads, placing f top soil and grouting of electroliers t the railroad separation structure is eing delayed because of the wet conitions resulting from the recent eavy rains, while at the El Camino Real separation structure minor work n the electrical and pumping systems emains to be done.

An amount of approximately $18,-00 has been expended in placing of op soil, irrigation pipes, and planting of trees and shrubs at the two eparation structures to achieve an ttractive and harmonious appearnce.

It is anticipated that the final work of constructing these two underpasses and landscaping the surrounding area will be completed on or about April 1, 1941.



Sketch shows El Camino Real highway underpass in foreground and University Avenue grade separation under Southern Pacific tracks in Palo Alto with side roads of semicloverleaf design connecting El Camino Real with University Avenue

Acres of Concrete Riprap and Cribs Placed to Protect Trinity River Banks

By F. W. HASELWOOD, District Engineer

IN December 1937 and in March 1940 the Trinity River went on a rampage. Each time it broke all previous records for height of water and damage to adjacent improvements. There is no certainty that the record for total volume of run-off was broken in either case because the gold dredging of recent years has so built up and modified the channel and so affected the flow that exceptional flood levels at unusual locations were not surprising.

Regardless of the contributing factors the flood plane of 1937 was from 2 to 8 feet higher than any high water level that had been determined prior to then and the flood level of 1940 was from 2.5 to 4 feet higher than that of 1937.

In 1937 and in 1940 severe damage was done to portions of the highway adjacent to the Trinity River. The 1937 restoration was not always of a type to guarantee against future recurrence of damage since the intervals between such floods was believed to be very long. In some cases, therefore, the 1940 flood caused damage at the same locations as the 1937 flood. Some of the greatest damage in 1940, however, was on sections of road which had survived attacks of the river for twenty years or more.

TWO PROPOSALS OFFERED

After the 1940 experience, it became necessary to revise theories as to the frequency of recurrence of such flood levels and, therefore, to resort to more substantial designs for protection of the restored road.

Two general proposals were considered, one to shift the road away from the river into solid ground and the other to restore in its present location with adequate protection of fill slopes or a combination of the two. In some cases instability and steepness of the hillside made cutting more hazardous than encroachment on the river and in such cases elaborate measures to protect fills were necessary.

The 1937 damage was confined to the road along the river between Junction City and Big Bar. Some of the 1940 damage occurred on this same stretch of road and some on a

Workmen placing strip of wire and rock mattress in river bed at foot of riprap protected slope

The above pictures show portions of 25 acres of sacked concrete slope paving placed on the banks of Trinity River for protection of the highway at flood stages. A total of 148,029 sacks was laid, approximately one sack per square foot section of road along the river for several miles east of Douglas City. This latter section was built about twenty years ago.

Included in the damage to this section was the partial destruction of two spans of the Douglas City bridge when an abandoned dredge broke from its moorings and floated down and struck the bridge and broke or damaged truss members of two spans. The damage to the bridge was repaired by contract handled by the Bridge Department in the Summer of 1940.

BANK PROTECTION MEASURES

When restoration by moving the road into the hill was not practicable, it was necessary to determine whether encroachment on the river side with protected fill slopes was practicable, and if not, to devise other means of restoration and protection. After a thorough study of local conditions and the availability and quality of local materials, it was decided that at those locations where encroachment on the river was impracticable, the concrete crib type of protection would be best.

At locations where encroachment on the river was practicable studies of the conditions at the various locations resulted in the use of three types of slope protection.

Where encroachment was small and fill slopes were parallel to the thread of the current, protection consisted of a slab of clean cobbles ranging from 4 to 8 inches or more in diameter. These were obtained from the waste from old placer mining operations. Where these cobbles were used in the 1937 restoration there was no loss in 1940.

Other fills of this nature were protected by a hand-placed rock fill slope comparable in its resistance to medium riprap. Rock for this purpose was obtained from locations where the road was moved into the hillside to avoid river encroachment.

At locations where the effect of the current on the fill slopes is more severe sacked concrete riprap was placed on the slopes and a strip of wire and rock mattress was placed in the riverbed at the foot of the slope. Concrete cribs were constructed from precast reinforced concrete members of several sizes, according to the depth of the crib. Unit prices applied to each size of crib member include the cost of furnishing material, constructing the members, hauling and placing them and backfilling the interior of the cribs with porous material.

Concrete cribs were constructed by Clifford Dunn of Klamath Falls, who had the contract for restoration between Helena and Big Bar and by Prison Camp 25 between Junction City and Helena. Mr. Dunn placed a total of 4,284 crib members, the average cost of which in place was $3.30 each.

15,000 CRIB MEMBERS

At Camp 25 approximately 15,000 crib members were made. At the time this is written the construction of the members is complete, but the placing is not. At the time of the latest cost analysis, the average cost of manufacture of 12,891 crib members was $1.66 each and the average cost of placing 9,398 members was $0.89. This indicates an approximate total cost of not over $2.55 per member.

There were 1,009 cubic yards of Class "A" concrete in the 12,891 crib members. The total cost of manufacture of these members was $21.23 per cubic yard of concrete required. Manufacture of these members was handled in a well organized and economic manner at Camp 25. Loading and placing was done by a specially constructed electrically operated hoist mounted on a two-ton truck.

On the unit east of Douglas City some three acres of sacked concrete riprap and about one acre of wire and rock mattress were placed in two units, one 350 feet long and one 2,500 feet long. For this riprap burlap sacks the size of ordinary barley sacks were used, each containing a cubic foot of concrete and were laid as headers, that is, the long dimension of the sack was at right angles to the slope.

148,029 SACKS LAID

A total of 148,029 sacks were laid of which 132,977 were on 133,696 square feet of fill slope and the balance were used in foundations and returns at the ends of the protection. One cubic yard of concrete covered 27.13 square feet of fill slope which is approximately one sack per square foot. The cost per square foot of such slope protection was 30.4 cents.

Wire and rock mattress consists of three longitudinal layers 8 inches thick and 4 feet 10 inches wide, of rock from 3 to 8 inches in diameter inclosed by substantial wire mesh with tie wires between the top and bottom layers 8 inches apart each way. The layers are securely wired together forming a mattress about 15 feet wide, which is laid on a slight transverse slope on the bed of the river at the bottom of the slope paving and is anchored by the cables attached to dead-men, located at 10-foot intervals.

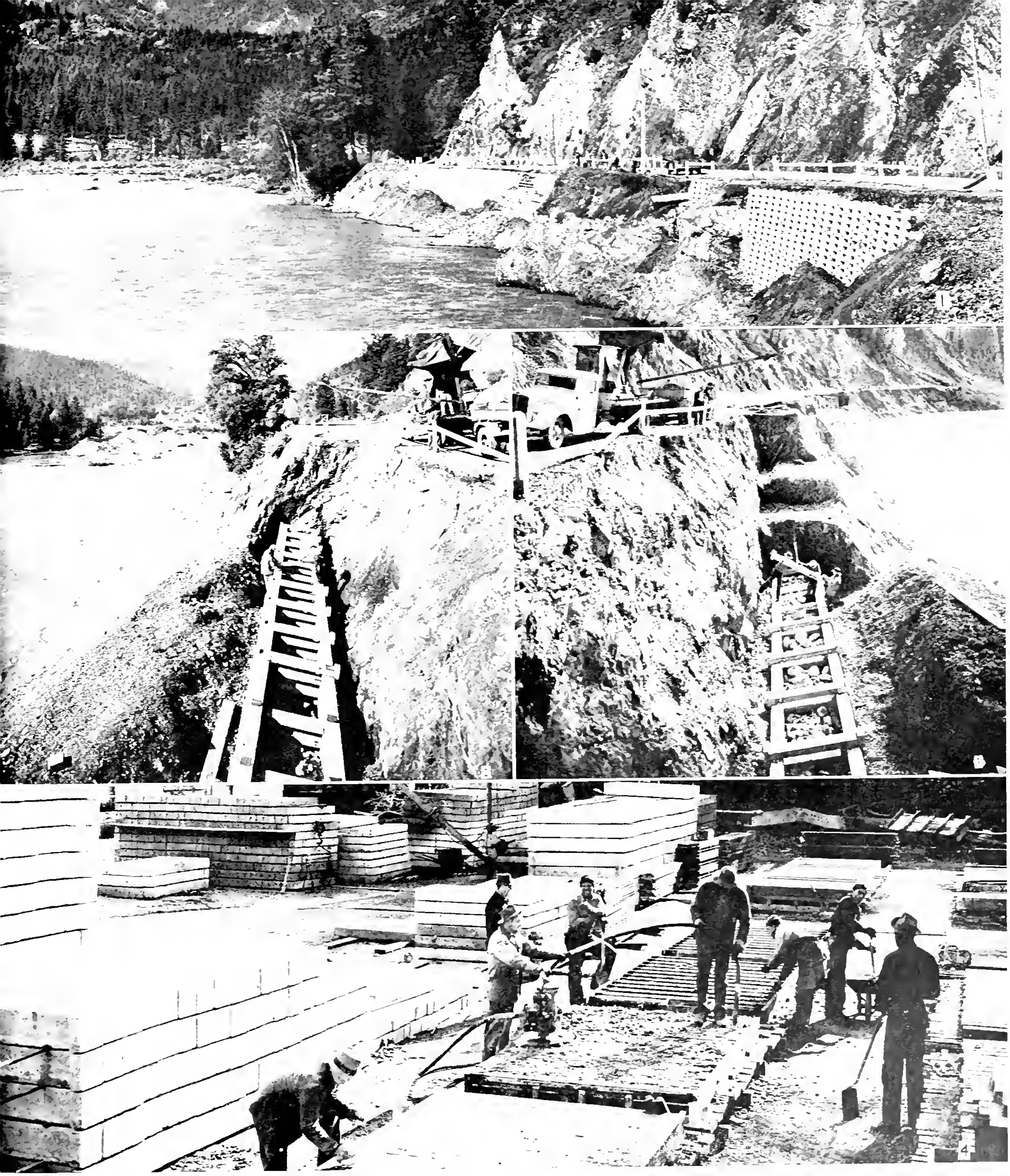
The filling material for this mattress was cobbles obtained from dredger tailings or gravel in nearby gravel bars. This mattress complete cost $2.20 per square yard, or 24.4 cents per square foot. Work of restoring the section above Douglas City, including the construction of the sacked riprap and the wire and rock mattress was done under contract by Hemstreet & Bell. C. A. Potter was Resident Engineer on this as well as the Clifford Dunn contract. Crib construction at the Prison Camp was done by Superintendent H. L. Waste with R. E. Ward as Resident Engineer.

Since this article was started, another extreme flood in the Trinity River occurred with the water level about 3 to 5 feet below the 1940 level. Although much damage was done to other sections of road between Redding and Douglas City, the slope paving along the Trinity River stood up with no damage whatever. Between Junction City and Big Bar, the damage was very slight and almost entirely due to the fact that the bituminous surfacing had not yet been restored.

BRITISH MOTOR CLUBS STILL GIVE SERVICE

In the face of wartime conditions, British motor clubs are continuing to render full services to car owners, according to word received from London.

The British motorist, however, must comply with a number of restrictions. Gasoline is being carefully rationed. Lights must be shielded against visibility from overhead. Automobiles and motorcycles must be made incapable of possible enemy operation when left unattended, usually by a master switch in a secret place or by removal of some vital part of the mechanism. Motorists must be constantly alert for road barricades and challenges from sentries. Identity cards, driving licenses and insurance certificates must be carried.



Precast cribbing protection on Trinity River. Below—Making 15,000 concrete crib members at camp between Junction City and Helena

New Swing Span Bridge and Ferry To Replace Butte City Structure

By W. A. DOUGLASS, Associate Bridge Engineer

WITH the rapid development and growth of population in the Sacramento Valley during the "gold rush" era came the demand for improved routes of travel. River traffic was first of primary importance, taking thousands of tons of grain to the seaport of San Francisco and bringing miners and mining supplies to the upper reaches of the Sacramento in Tehama and Shasta counties.

As early as 1878 there were 200,000 tons of shipping on the river. Roads were necessary to and from the river landings and from one settlement to another. One such road was that connecting Glenn County with Marysville, Oroville and the east side of the Sacramento River.

At first low water fords and ferries provided the necessary stream crossings. This, of course, meant that the roads were closed during periods of high water, which lasted probably six months of the year.

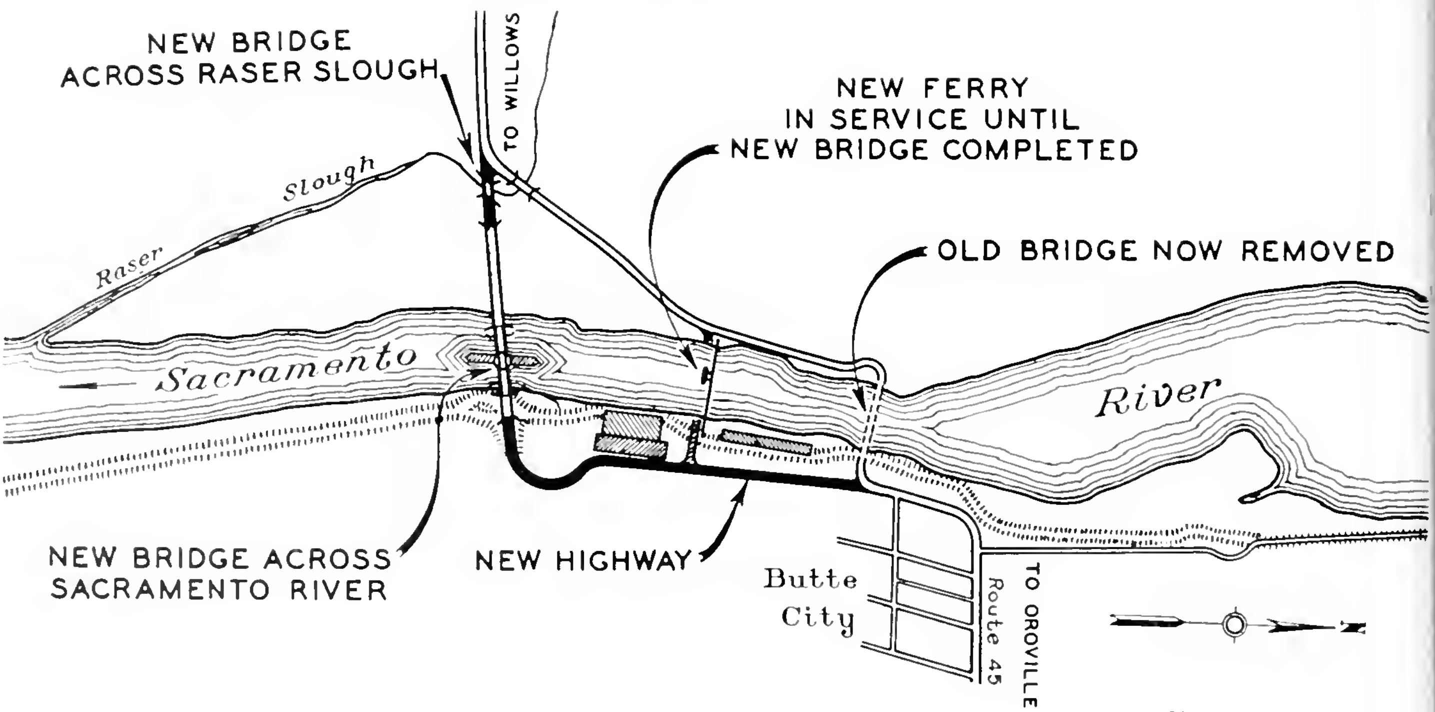
In 1892 a bridge to handle traffic on this route was built across the Sacramento River at Butte City. Since the Sacramento is considered navigable as far as Red Bluff, a swing span was necessary to permit the passage of boats. Records of this early construction are not too complete, but apparently exceptionally high water caused the failure of the first structure almost as soon as it was built.

The second structure stood until 1904 when a boat collision dumped the swing span into the river. Glenn County rebuilt the bridge in 1905 and '06, and the approach spans were rebuilt in 1914. Although designed for freight wagons drawn by jerk-line teams, this bridge was maintained and kept in service until late in 1940.

The supporting pier for the swing span was founded on timber piles driven from 50 to 60 feet into the mud and extending from the mud line nearly 30 feet to the bottom of concrete just below the water surface. Submerged drift and rolling debris battered and damaged these timber piles, gradually weakening the supports for 30 years.

In 1934 it was noted that the swing span was slightly out of line, indicating a tipping of the pier. The amount of tipping increased gradually, until in 1939 the swing span was nearly a foot from its original position with the rate of movement increasing rapidly.

Although every effort was made to save and maintain the structure as long as possible, the movement became so rapid and extensive that late last year it became unsafe and was closed to traffic. In fact the stability of the structure was so endangered



Sketch showing locations of old and new bridges, ferry and new highway at Butte City hat the contract was let immediately for the removal of the bridge before high water in the winter of 1940-41, as it was feared the span might tip into the river and entirely block the stream for navigation.

STATE BUILDING FERRY

Although the traffic count on Highway Route 45 at this location is only about 500 vehicles per day, it is a very important crossing for a number of agricultural products to and from the warehouses and shipping points in that vicinity. It was, therefore, considered necessary for the State to go into the shipbuilding business and provide a ferry for use during the construction period of the new bridge. The ferry boat, machinery and connecting roads are now under construction, and it is expected the ferry will be in service within the next few weeks.

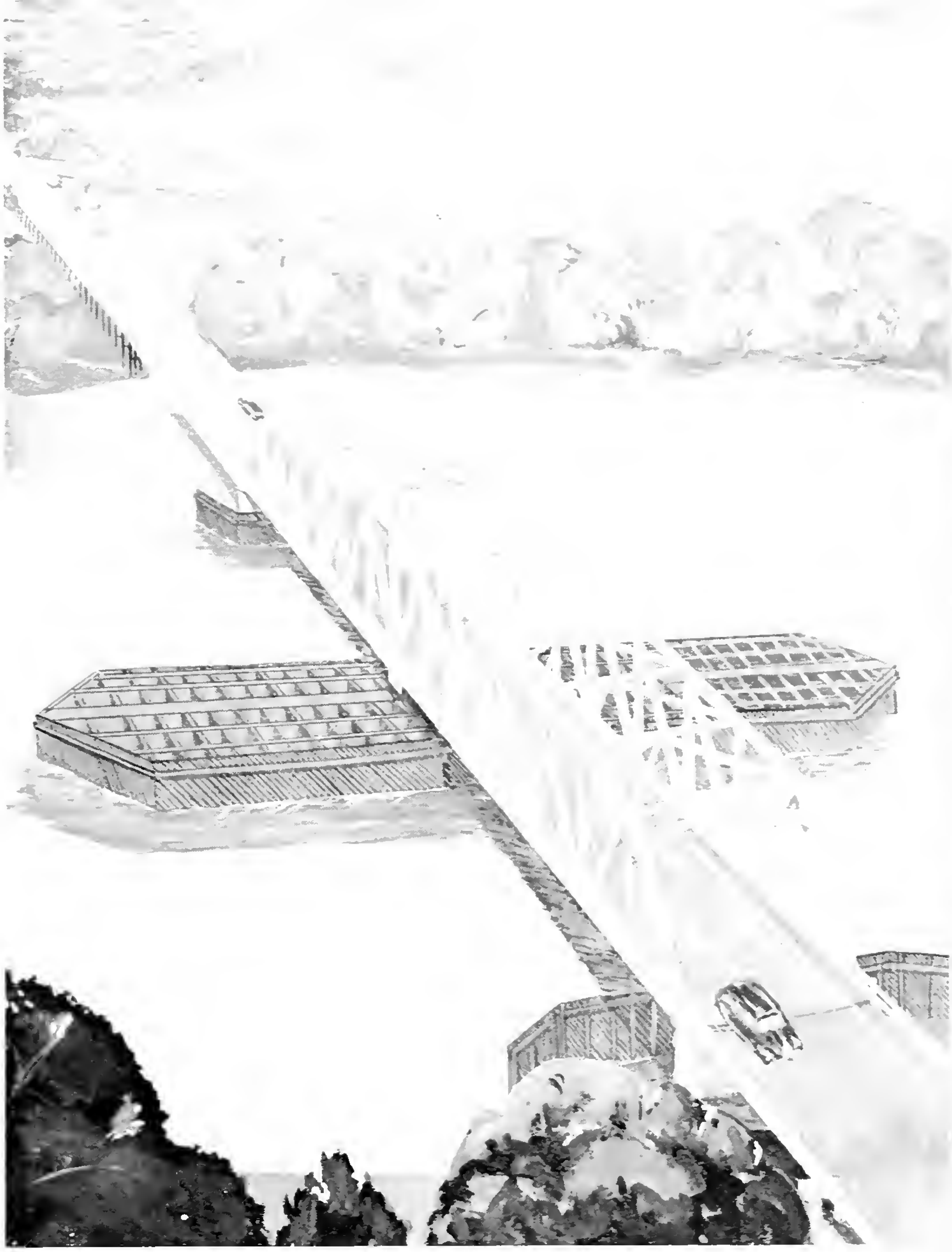
In the meantime traffic is being detoured by way of the Princeton Ferry some three or four miles downstream. This is a county ferry which serves traffic very efficiently, but was not designed or built for operation during extreme high water. It is planned that the new State ferry will remain in service during practically the entire winter season.

The ferry will carry a gross load of 15 tons, which will permit the movement of rice and other products without serious inconvenience. In the meantime the necessary steps are being taken to prepare for the construction of a modern bridge on improved alignment about 2,000 feet downstream from the original bridge.

SWING SPAN APPROVED

After a formal hearing the War Department issued a permit for the construction of a swing span, which provides over 100 feet clear width for navigation on either side of the center pier. The swing span is to be equipped with modern power and machinery for rapid opening and closing to avoid delay either to the river or highway traffic. The bridge will provide a 26-foot roadway on good alignment and easy grades so that the river crossing in either high or low stages will offer no obstacle to highway transportation.

The ferry together with necessary power plant, cables and ramps will cost about $25,000. But this expenditure is justified by the saving in travel distance for the traffic using the highway; and after it has served its purpose here, the ferry will be kept as reserve for other ferry crossings maintained and operated by the State.

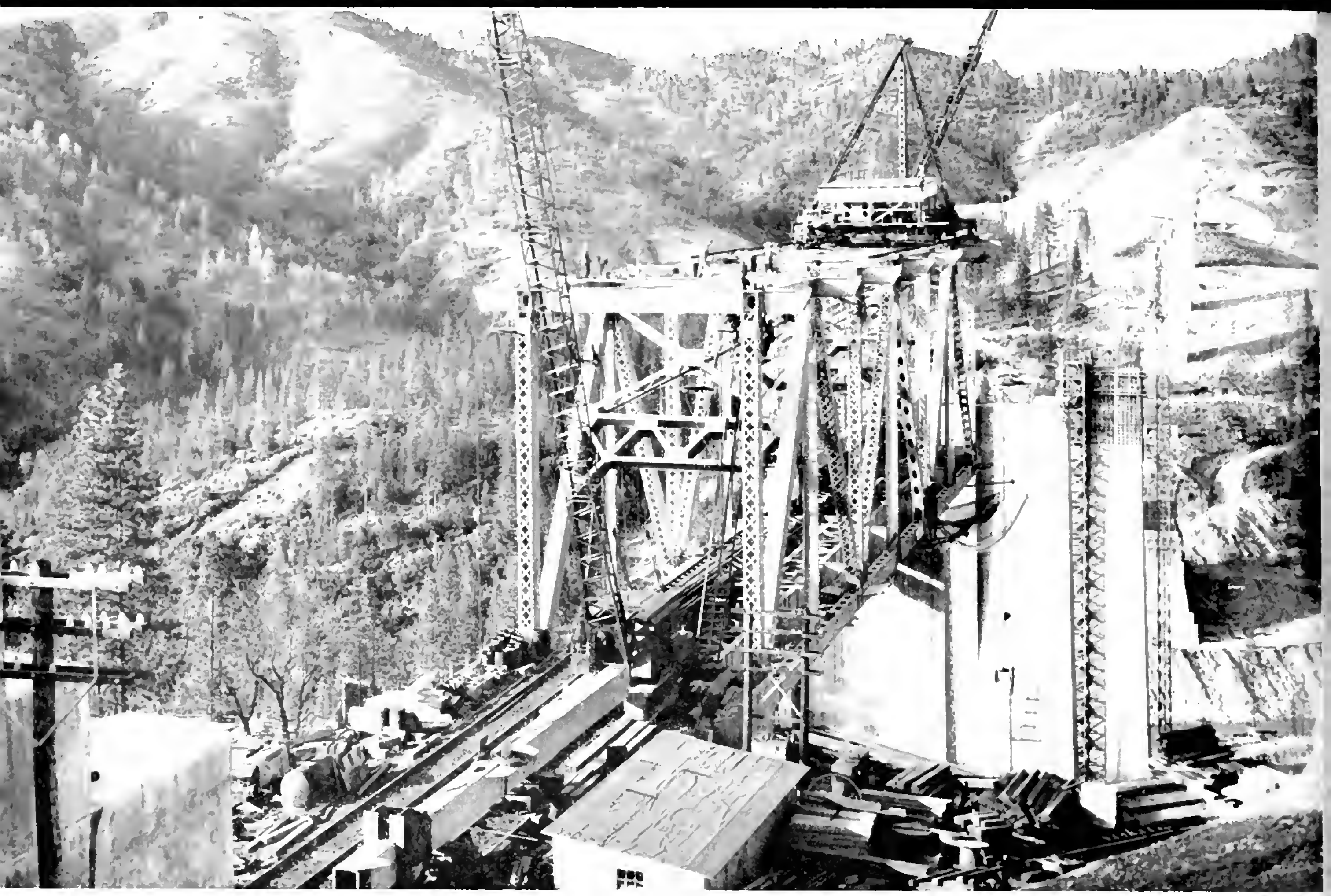


Drawing of proposed new swing span steel bridge across Sacramento River at Butte City and its highway approaches by J. D. R. Chamberlain, Division of Highways

IMPROVEMENT TOTALS $4

The new bridge and approaches will cost approximately $400,000 and will be of modern type of design similar to the bridge now being constructed over the Mokelumne River between Lodi and Rio Vista. Plans for this new structure are now practically complete, and it is expected construction will begin early in the summer of 1941, as soon as contract funds provided in the 93d-94th Fiscal Year Budget become available.

Unless there is too much delay in the delivery of steel because of the present National defense demands on the steel industry, it is expected the structure should be completed within 12 to 15 months. That is by the late summer of 1942. In the meantime a gap in an important agricultural highway will be closed when the new ferry is put in service during the spring of 1941.



First steel construction on Pit River double-deck highway and railroad bridge across Shasta Dam Reservoir site

Pit River Bridge Construction

CONSTRUCTION progress on the five million dollar Pit River Bridge, the closing link in the railroad and highway relocations around the Shasta Reservoir site, indicates completion of this spectacular unit of the Central Valley Project early next fall.

While contracts for the great span awarded by the United States Bureau of Reclamation are being speeded up, the Division of Highways of the Department of Public Works is keeping pace in the building of 12½ miles of realignment of the Pacific Highway around an arm of the reservoir.

Erection of structural steel has started on the Pit River Bridge, the world's highest double-deck span. A 24-ton section of a 140-foot truss, part of the bottom chord on the right side extending from the south railroad abutment was the first piece of steel to be swung out over the canyon and into place on the huge concrete piers, most of which are completed. The first floor beam of the railroad deck which will carry the tracks of the Southern Pacific Railroad has also been erected.

The superstructure of the bridge will require 17,110 tons of steel fabricated in the plant of the American Bridge Company in Gary, Indiana, and now being shipped across the country to the Pit River Canyon, 14 miles north of Redding. Steel is being taken to Redding over a finished section of the relocated railroad and delivered to the material yards on the reservoir site.

Ralph Lowry, Construction Engineer of Shasta Dam, the Pit River Bridge and other Central Valley Project features, has reported to Acting Supervising Engineer R. S. Calland that work is progressing on the concrete substructure of the bridge, with all piers and abutments completed except piers 3 and 4 in the center of the canyon which have risen more than two-thirds of their ultimate height of 350 feet, and will support a cantilever span 630 feet long.

In addition to the 630-foot central span there will be two 497 foot, three 282-foot, two 141-foot deck truss spans, one 150-foot and four 141-foot deck girder spans. The bridge will be 3,588 feet long.

Provision has been made for two railroad tracks through the trusses and for a four-lane highway over the top. At the end of the major spans, the railroad and the highway will go their own separate ways by a construction design that separates them horizontally.

The upper deck of the bridge will be 500 feet above the present level of the Pit River and will carry four lanes of U. S. Highway 99. The lower deck will carry two tracks of the Southern Pacific's main line between San Francisco and Portland, Oregon. Northbound trains will pass directly on to the bridge from a half-mile tunnel bored through Bass Hill on the south side of the Pit River Canyon which will become a part of Shasta Reservoir.

The roadbed grading, all 12 tunnels and six of the eight major bridges on the 30-mile railroad relocation are completed with the track laid on about 25 miles of the new line. On the 15-mile highway relocation, a $2\frac{1}{2}$ mile section contracted for by the Bureau of Reclamation has been opened and the remaining $12\frac{1}{2}$ miles are under construction by the State of California.

On February 26th, bids were received by the Bureau of Reclamation in Sacramento for the construction of a centralized train traffic-control system and telephone and telegraph communication facilities in connection with the railroad relocation.

Acting Supervising Engineer Calland of the Central Valley Project said the work includes installation of a complete signal system for operation of the new Southern Pacific line between Redding, which is 12 miles below Shasta Dam, and Delta Station at the upper end of the reservoir area.

The contractor must furnish and install highway-grade crossing signals and other equipment for the protection of trains on the new route, as well as complete telegraph and telephone communication systems for the Southern Pacific Company and the Western Union Telegraph Company.

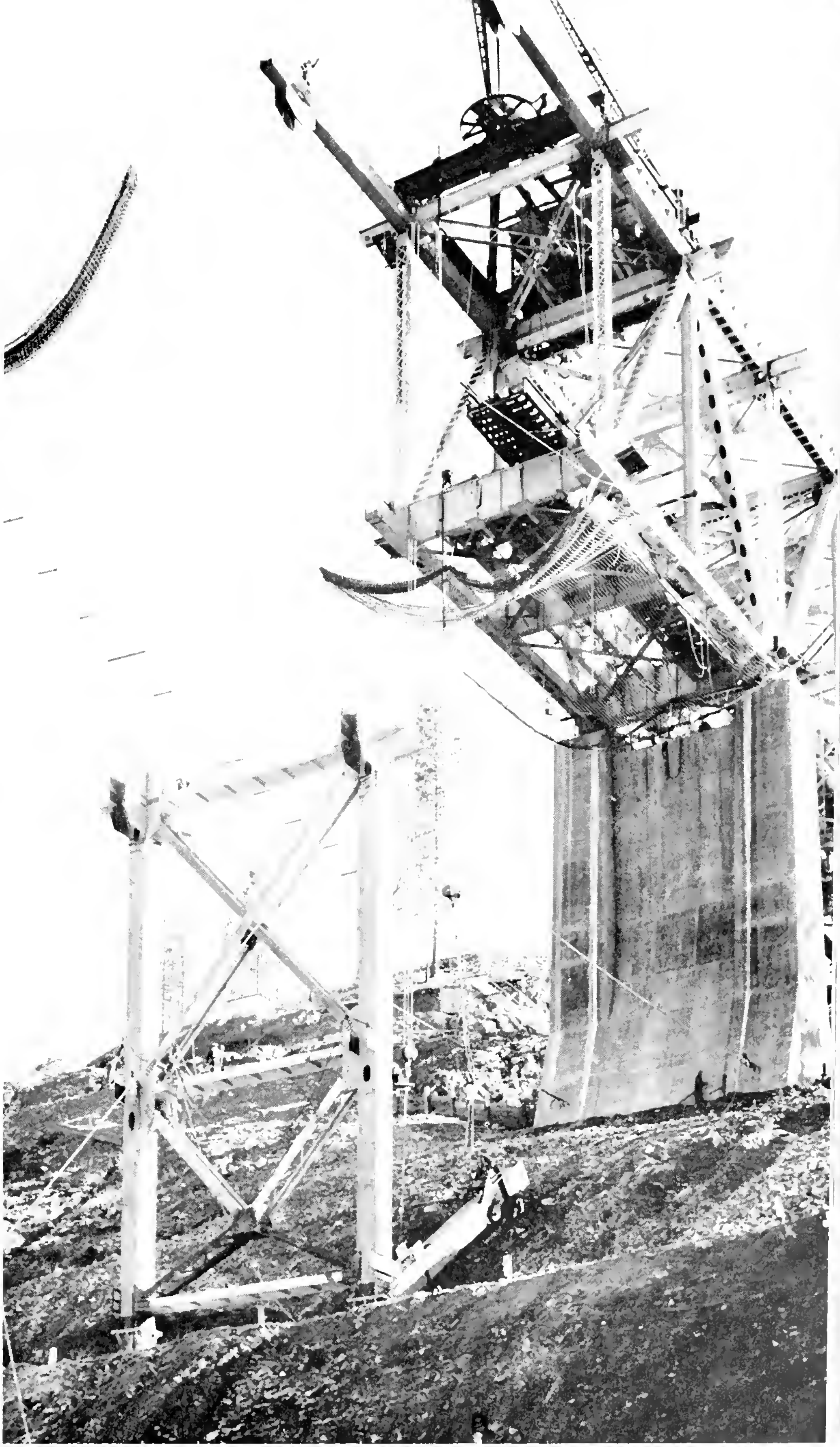
The successful bidder will be allowed 210 days to complete the work from the date a notice to proceed is received from the Bureau of Reclamation.

ONE WAY

Professor: "Can you give me an example of wasted energy?"

Student: "Yes, sir, telling a hair-raising story to a bald-headed man."

And the freshman engineer who thought that a slide rule is a regulation pertaining to baseball.



The workman on the top steel girder of the Pit River Bridge is 500 feet in the air. Steel safety nets are provided

Relocation of Pacific Highway Unit North of Red Bluff Completed

THE relocation of an obsolete section of U. S. 99, the Pacific Highway, in Tehama County north of Red Bluff, has been completed and opened to traffic. The new highway unit is six miles long, 34 feet wide and has a roadway 200 feet in width. It replaces a 20-year old highway of 15-foot pavement and eliminates many curves and grades on the old alignment.

The new road embodies the best standards that engineers now know for safe traffic and is designed to be perfectly adequate for military movements. The design provides for a free flow of traffic at all points at the present legal speed and with one short exception at speeds of 60 miles per hour.

RECORD VERTICAL CURVE

To cross a low, broad ridge beginning about a mile out of Red Bluff, the problem of securing the minimum sight distance of 2,200 feet offered a severe challenge and was finally solved by the use of a vertical curve 8,000 feet long, which is a record for length of any such curve on any highway.

For nearly half its distance, the highway relocation encroaches on the channel of Blue Tent Creek. This is one of those creeks that has a broad, gravelly bed, from 200 to 500 feet wide, with a small flow in normal winters that meanders back and forth in a poorly defined channel but in flood times covers almost the entire stream bed.

CREEK CHANNEL CHANGE

To provide assurance that this flow would not disturb the highway, which occupies portions of the old stream bed, a channel change 2.5 miles long was made taking the stream about 250 feet away from the road.

The highway relocation includes a bridge 135 feet long across Blue Tent Creek and another 160 feet long across Dibble Creek.

The new unit, which is virtually a long straight-a-way, has a cement stabilized base with a substantial and durable surface suitable for heavy main line traffic. Gravel from the Blue Tent Creek channel change was spread over the entire width of grade to a compact depth of six inches. Additional gravel from the stream bed was crushed to one-inch maximum size and mixed in a large concrete mixer with 6 per cent of cement and sufficient water to provide optimum moisture and maximum compaction.

BITUMINOUS MIX SURFACE

This mixture was spread on the road to a width of 24 feet and to a compacted depth of six inches and rolled with a 12-ton roller and covered with one-fifth of a gallon of asphaltic emulsion to a square yar[d] to prevent evaporation during th[e] curing period.

Over this stabilized gravel base wa[s] placed a plant-mixed, machine-sprea[d] surfacing of bituminous mix thre[e] inches thick and 22 inches wid[e]. Bituminous mixed shoulders are fiv[e] feet wide on each side. The entir[e] cost of the project was $225,000.

School Sends Thanks

GARDEN GROVE ELEMENTARY SCHOOL

Garden Grove, California
January 8, 1941

State Department of Highway Maintenance
Santa Ana, California

Gentlemen:

Recently you applied some surfacing to the shoulder of the road in front of our Lincoln School, located just east of Garden Grove on Ocean Avenue.

This is very much used for the loading and unloading of children. During wet weather it has been very muddy. This piece of good work has proved very valuable in the rainy time thru which we have just passed, by keeping the children off the wet ground.

At a recent meeting of the board of trustees it was the unanimous action of the board that I write and express the sincere thanks of this body for the good work you have done.

Yours very truly,

(Signed) S. W HOLT,
Clerk, School Board.

Two Engineers Retire From Service

A party is being arranged for th[e] very near future by the Division o[f] Architecture to honor two of its mem[-]bers who have recently retired afte[r] many years of service.

W. B. Rohl, Associate Engineer General Construction, retired i[n] February. He has devoted a ver[y] active life in the construction busi[-]ness in California and elsewhere, and since early in 1928 was in charge of various important construction proj[-]ects at institutions throughout th[e] State.

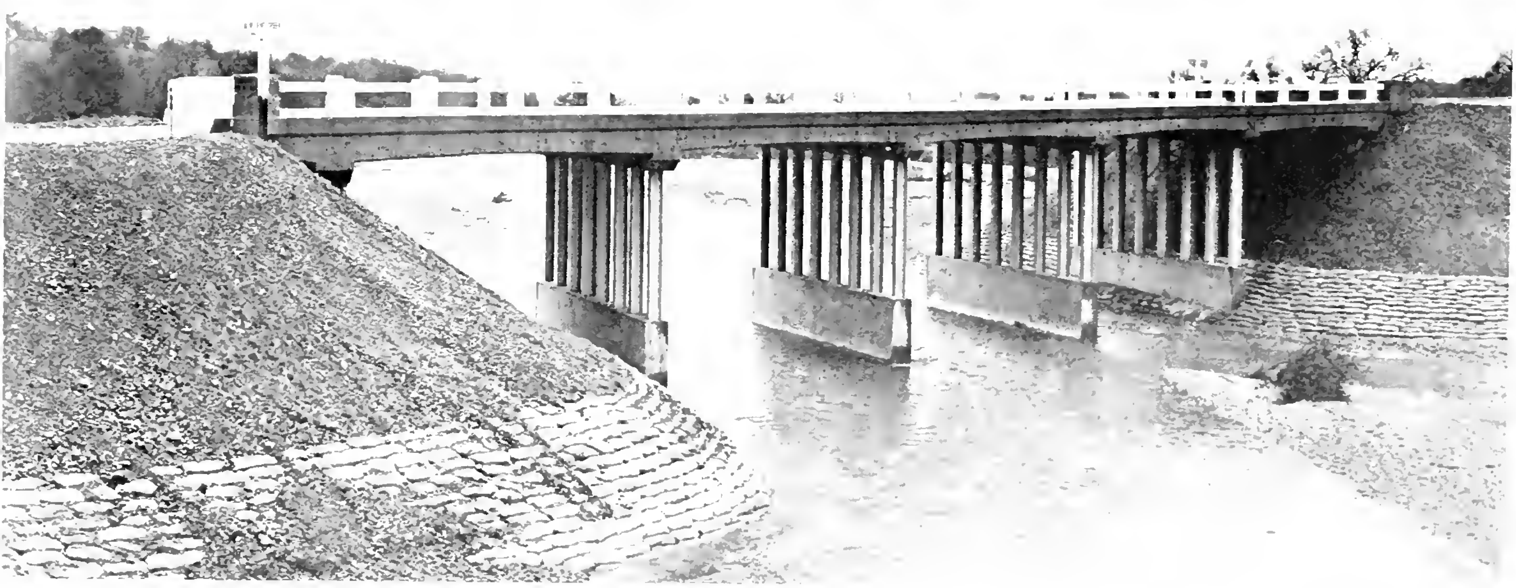
Oliver L. Morton, Supervising Engineer, General Construction, in the field forces of the Division of Architecture, will retire this month after approximately thirty-three years in the service of the State.

Mr. Morton's first assignment was the supervision of the construction of new buildings at the Preston School of Industry, where he introduced the manufacture of brick by inmate labor for construction of subsequent buildings at the institution.

Assignments at Mendocino and Stockton State Hospitals, and Humboldt State College followed until 1922, since which time he has been in charge of the Division's work in the Napa and Sonoma Districts, where he has ably represented the Division of Architecture in some of its most important projects.

Sailor: "You aren't getting seasick, are you buddy?"

Recruit: "Not exactly, but I'd hate to yawn."



Six mile relocation of U. S. 99 north of Red Bluff just completed includes a 160-foot concrete slab bridge on steel piles across Dibble Creek and a 135-foot bridge of same type across Blue Tent Creek shown in top and bottom photos

Cement Stabilized Base Used In 4-Lane Highway Construction

By A. EVERETT SMITH, Assistant Highway Engineer

A PORTION of highway on U. S. 99 extending from the junction with U. S. 60, at Beaumont, to Banning is nearing completion. This project is of especial interest as it will transform the existing road into a four-lane divided highway and is the first State highway project in this district to utilize a cement stabilized base.

The project, in general, was the construction of two new traffic lanes 6.12 miles in length adjacent to the existing two-lane paved road, thus providing a four-lane highway. Divisional strips have been constructed to separate opposing lanes of traffic. Through Beaumont and a portion of Banning a wide street section was graded and paved without installation of dividing strips.

The work on this project was quite extensive, consisting for the most part of grading; placing, rearranging and extending numerous drainage structures; constructing curbs, gutters, and driveways; installing a flashing light system in connection with termini of central dividing strips; placing cement stabilized base and topping the base with plant-mixed surfacing.

Also included in this work was channelization of traffic lanes at the intersection of U. S. Highways 99 and 60 at the west end of the project near Beaumont.

The cement stabilized base consists of selected material, Portland cement and water each in proportioned amounts mixed in a mixing plant, and placed on the roadbed, compacted and cured.

The selected material was excavated from the middle fork of San Timoteo Creek and mixed in the contractor's plant at the same location. The plant was an all steel portable type using a two yard capacity single shaft mixer.

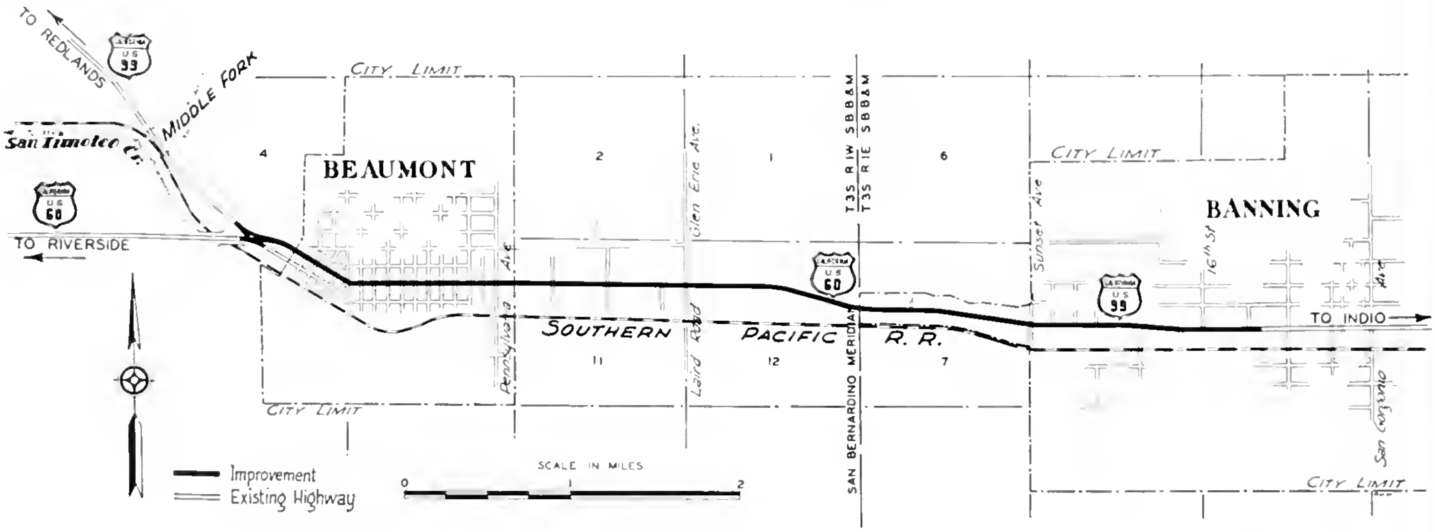
Material was hauled from the creek bed with RD-8 tractors and carryall scrapers and dumped over a trap and by automatic feed was conducted to an elevating bucket line. It was screened by vibrating screens into bins from where it was drawn into the batch box and weighed by multi-beam scales. The minimum mixing time was 45 seconds.

At first, 1½ yard batches were mixed. This was increased to the mixer's capacity of two yards.

As a point of economy, the grading specifications were made to conform closely to the screen analysis for this pit and the waste was negligible. Approximately 90% of the pit material passed the 4-mesh screen. The job was started using cement at the rate of 6% of the base material by weight. This was later increased to 7%.

Approximately 10% to 11% of water was required in the mix. This particular material was quite critical and necessitated close control.

The mixture was hauled to the street in dump trucks and placing was commenced at the point farthest from the plant.



Sketch showing section of U. S. 99 being transformed into 4-lane divided highway between Beaumont and Banning

EXPERIMENTS IN METHODS

As the procedure of handling this type of base was new to contractor and engineers, considerable experimenting in methods of placing and compacting was done in order to obtain the best results.

Standard asphalt pavement speader boxes were first tried in spreading the base material on the street. The required compacted thickness ranged from 6 to 9 inches. Due to a very high bulking property of this mixture, it was necessary to spread a thickness of approximately 14 inches to obtain a compacted thickness of 9 inches. This required cutting an extra large outlet opening in the spreader box. Due to lack of sufficient rigidity in the box and difficulty in keeping the spreader box ends filled, it did not give a uniform spread.

As a trial method material was truck-dumped on the street and spread with a bulldozer. This also proved to be unsatisfactory.

SPECIAL BULLDOZER BLADE

After exhausting various methods for spreading the material, a bulldozer blade was equipped with steel wings extending forward about four feet from the ends of the blade. The forward ends of the wings were mounted on wheels and adjusted for elevation above grade. This worked quite well except that the mixture on being dumped from the truck, was partly consolidated by virtue of its mass, at the center and less consolidated near the ends of the blade. This resulted in a crown section after rolling.

To eliminate the crown in the finished base, adjustable steel plates were placed along the bottom of the bulldozer blade, and set to give a section that after compaction would be even and of the required thickness.

Trucks while dumping were pushed by the bulldozer and as much mix as possible was kept in front of the blade at all times. Some hand shoveling was necessary to keep the proper amount near the ends of the blade.

SPREADING AND COMPACTION

Spreading was accomplished one-half width at a time. Single spreads were advanced up to 50 or 75 feet; the other half was then brought up.

Compaction operations were first tried by using a sheepsfoot tamping roller, but due to the high per cent of fine material in the mix, the feet of the roller tore up the material to such an extent that it was unsatisfactory.

Compaction was accomplished by using a 12-ton, 3-wheel roller behind the spreader. This was followed by shaping with a motor grader having a 12-foot blade.

A 1600-gallon tank truck was used to apply a fine spray of water through a 12-foot spray bar, as necessary, to keep the exposed surface from becoming dry.

Tandem and three-wheel rollers used for finish rolling caused surface

(Continued on page 27)

At top—Truck dumping cement stabilized mix in bulldozer spreader box. Below—Bulldozer equipped with forward steel wings attached to ends of blade and wheels spreading mixture approximately 14 inches deep on roadway

First Link of 3-Lane Short Cut Highway to Watsonville Under Way

CONSTRUCTION of the new highway between Watsonville and Rob Roy Junction in Santa Cruz County is under way following official ground-breaking ceremonies held February 13th.

The work now under way consists of the first contract in a construction program which it is planned will eventually provide a modern thoroughfare from Watsonville and the Pajaro Valley to Santa Cruz.

This first contract will include the grading and installation of drainage structures on 6.2 miles from the northerly end of Main Street in Watsonville to a point 1.7 miles south of Rob Roy Junction. Plans and specifications call for a roadbed 47 feet and 64 feet in width. The finished highway will be constructed three lanes in width with transitions to four-lane widths where provisions for safe passing make the extra lane necessary.

MILLION YARDS OF EXCAVATION

Grading of the roadbed will involve the excavation of nearly one and a quarter million cubic yards of earth, and a million yards of excavation is a big job at any location. There will be over 13,000 cubic yards of excavation for structures, ditches and channels. While no major bridges will be required, culverts and headwalls will need 500 cubic yards of concrete and over 56,000 pounds of reinforcing steel. In addition to the reinforced concrete drainage structures, there will be nearly 5,000 lineal feet of corrugated metal pipe culverts and 4,000 feet of metal pipe underdrains.

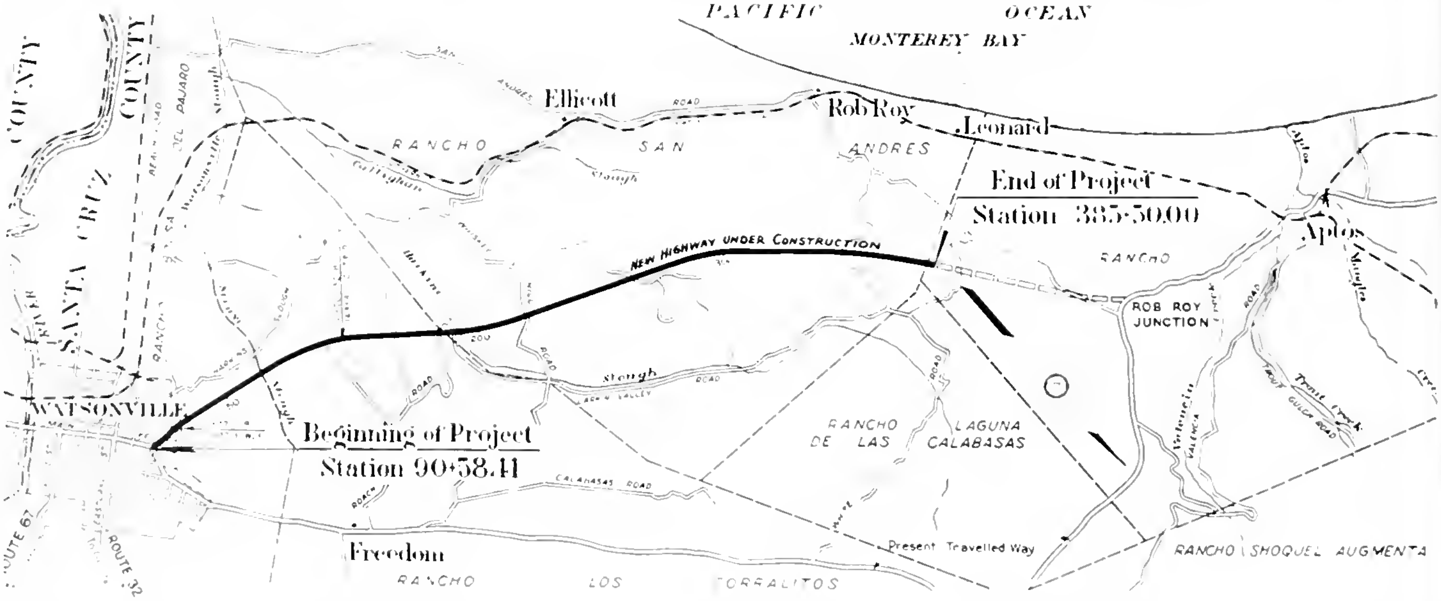
One of the major problems confronting the engineers on this project involved the placing of heavy embankments over the marshy ground at both Watsonville Slough and Harkins Slough. The method being used to reduce the water in the underlying material to a point where that material can support the weight of the embankment, will consist of placing numerous vertical sand drains through which the water in the subfoundation is forced to the surface by the weight of the fill. From the surface it is carried off by adequate drainage channels. This method of stabilizing embankment foundations has been found both adequate and rapid on several recent highway projects. It is estimated that on this project about 16,200 lineal feet of such drains, from 18 to 24 inches in diameter, will be required.

FUNDS BUDGETED FOR COMPLETION

The grading of this six miles of new highway will require about 11 months and the cost of this first stage of construction is estimated at about \$285,500, which is being financed from both State and Federal Aid funds. Its completion will have accounted for the most difficult portion of the program for improving the coastal road in this vicinity.

While the limited funds available during the current biennial period permitted only the beginning of the program, there is included in the highway budget for the coming biennium, adopted by the California Highway Commission on December 31, 1940, the sum of \$350,000 for grading the remaining mile and three-quarters from the northerly end of the present contract to Rob Roy Junction and for surfacing the entire eight miles between Watsonville and the Junction.

Thus, within the next two years, construction of this one eight-mile section will save more than two miles in the travel distance between Watsonville and Rob Roy Junction, and it is anticipated that the program of reconstruction of the entire section



between Santa Cruz and Watsonville will quickly follow this beginning.

SHORE LINE ROUTE

When in 1933 the State Highway System was increased from some 7,200 miles to nearly 14,000 miles, there was included a route designed to extend the Carmel-San Simeon road which was then under construction, northerly along the shore of the Pacific, as a State route. In incorporating this shore line route into the State system, existing county roads were taken over by the Division of Highways as the basis for the ultimate coastal highway.

Immediately after these roads became part of the State system, surveys were begun over portions of the route from Carmel to San Francisco and, north of the bay, in Marin, Sonoma and Mendocino counties. As rapidly as available funds would permit, the poorer sections of these county roads have been reconstructed to alignment, grade and width compatible with the increasing traffic in the shore-line areas.

From San Francisco southward, major reconstruction has been advancing through Farallon City, Half Moon Bay and Tunitas in San Mateo County. In Santa Cruz County improvement has been made north of Santa Cruz from Davenport to Waddell Creek, and it is expected that these newly constructed sections will be connected during the coming two years by reconstruction between Tunitas and the northerly end of the improvements in Santa Cruz County.

TRAFFIC INCREASE MARKED

Included in this program of the State has been the major reconstruction of that portion of the route between Santa Cruz and Watsonville. Rapid development of beach properties and growth and expansion of both Watsonville and Santa Cruz have resulted in a marked local traffic increase along the old Watsonville road, which, when coupled with the increasing volume of through traffic, at times approaches congestion.

Reconnaissance surveys made from Watsonville northerly by State highway engineers indicated certain definite controls for the most economical location of line and grade compatible with modern standards of suburban highway construction, and upon the basis of these, the location was selected.

Bids for the new project were opened by the Division of Highways on November 27, 1940, and on December 2, 1940, Director of Public Works Frank W. Clark awarded the contract for the work to N. M. Ball Sons of Berkeley, who submitted the lowest bid.

With the Kiwanis Club acting as host, the Watsonville Chamber of Commerce on February 13th tendered a luncheon to State, Federal, county and city officials and to the heads of the Santa Cruz Chamber of Commerce, preceding the ground-breaking ceremonies.

If you are bent upon a little private discipline wait until you are choking with thirst, then take a mouthful of cold water and spew it out again—and tell no man.—*Epictetus.*

Congress Committee Asks for Magazine

HOUSE OF REPRESENTATIVES, UNITED STATES

Committee on District of Columbia, Washington, D. C.

February 6, 1941

California Highways and Public Works,

Sacramento, California.

Gentlemen: The District of Columbia Committee of the House of Representatives is making a study of the traffic conditions in the District of Columbia.

The Hon. Carl Hinshaw brought to the attention of the committee your publication, "California Highways and Public Works," October, 1940. The members of the committee had an opportunity to examine this issue only in a cursory manner, but found it most enlightening.

I will appreciate it if you could send me 10 copies of this issue. It would also be appreciated if you would place my name on the mailing list to receive further publications.

Yours very truly,

JENNINGS RANDOLPH,
Chairman.

Relationship of Road Officials to National Defense

IN HIS address at the last meeting of the American Association of State Highway Officials Thomas H. MacDonald, Commissioner of Public Roads, spoke significantly as follows:

"Every crisis in our national life presents the opportunity for intelligent readjustment of our public policies, and compels from all citizens, worthy of the name, a wholly voluntary rededication of their first loyalty to the best interests of our country. In this twenty-sixth annual meeting of the American Association of State Highway Officials we focus our deliberations upon the broad fields of highway development and highway utilization, but with a new emphasis over previous years.

"At no previous conference in the long life of this Association, or during the more than a quarter century of State-Federal cooperation in road building, has the relationship of highways to the National defense become such a vivid reality.

"While there is considerable substance to support the conclusion that the entrance into, and the scale of participation in a national highway program on the part of the Federal Government, were in a large measure products of the first world war, there was then no very clearly defined conception of the defense functioning of highways, and certainly in a relative sense, no important development of a motorized transport or a mechanized army.

"During these many years the national defense argument has been liberally and loosely used in support of Federal road building appropriations with a complete lack of precise analysis of the potentials of defense utility.

"So now grave necessity presses for the reaching of National understandings, in particular among the highway officials, and in general on the part of the public, upon this subject of defense highways. In a large measure it is a pioneer undertaking for which there are literally no precedents.

* * * * *

(Continued on page 31)

New Standard Specifications Issued by Division of Highways

By JOSEPH M. KANE, Assistant Office Engineer

THE printing of a new edition of Standard Specifications of the Division of Highways to control both highway and bridge work was completed in October, 1940. On November 15, 1940, this new edition was placed in effect and superseded the older Standard Specifications dated January, 1935, for all work initiated after November 15, 1940.

The first formal edition of Standard Specifications for use in California highway construction was issued in 1925 and since that time, revised editions have been published in 1927, 1929, 1930, 1935 and 1940. In the last two editions the size of the volume was changed from the original 8½" x 11" book to the more convenient textbook size of 6" x 9".

Previous to 1925 all of the general specifications common to all contracts were included in the printed folder containing the proposal form in much the same manner as the special provisions are published today. This involved the inclusion of a large amount of material which was repeated in each contract and required reprinting many pages.

CONTRACTUAL REQUIREMENTS

The first 41 pages of the new 1940 Standard Specifications contain, in general, requirements defining the contractual relationship of the contractor to the State, methods of controlling material involving descriptions of test procedures, the relationships between the contractor and public traffic and also methods of measurement and payment for contract items of work.

Formerly before the issuance of a volume of Standard Specifications, all of these matters were covered by about 12 pages of printed matter in each contract form. Conditions have changed very materially over the last 15 years and the general requirements have become more stringent and considerably enlarged.

The Washington office of the Public Roads Administration, formerly the Bureau of Public Roads, recommended that all general specifications for the various States be included in one separate volume for convenience in reviewing plans and contract documents. That office issued instructions as to the form to be followed, the subjects to be covered and the order in which these subjects were to appear.

FOLLOWS WASHINGTON FORMULA

The underlying purpose of these instructions is to standardize the work as nearly as possible throughout the 48 States in order to reduce as much as possible the labor involved in reviewing plans and specifications for approval. It is, of course, impossible that the same set of Standard Specifications can be made to apply to all the States due to varying conditions of locality, climate, geographical features, etc. However, all of the States now issue Standard Specifications to control highway and bridge work, and in each instance the formula established by the Washington office is closely followed.

The Washington office of the Public Roads Administration also defines in general the order in which the sections defining the various types of construction shall appear in the bound volume of Standard Specifications. It is to be noted that the order of the sections in the 1940 Standard Specifications differs slightly from the order in the previous volume, having been changed to conform to requirements of the Washington office of the Public Roads Administration.

REQUIRED TWO YEARS STUDY

The preparation of the 1940 edition evolved a study of approximately two years. In order to compile the necessary data on which to base all of the revisions contained in this volume, it was necessary to obtain the suggestions from the heads of all departments and of the districts of the Division of Highways. It is obvious that all of these suggestions could not be followed, due principally to requirements affected solely by local conditions in some of the districts, and also because of various conflicts in ideas.

In preparing Standard Specifications, an earnest effort is made to include only such requirements as are generally applicable throughout the State and not to include various pet ideas, even though such ideas are justified in certain localities.

Many of the States issue addenda to their Standard Specifications from time to time in an attempt to keep the Standards up to date and to correct obvious errors. This practice has not been followed in California because it is considered dangerous practice to send out corrections because certain interested parties may fail to receive the corrections and thus not be informed as to the proper method to follow in bidding or in furnishing materials.

BOUND VOLUME PREFERABLE

On the basis of the same argument, it is also considered unwise to use loose-leaf volumes for Standard Specifications. With the use of a bound volume, no changes are possible except as outlined in the special provisions for individual contracts.

In the new volume of Standard Specifications, all references to commercial catalogues and rules of various producers in connection with their products and materials have been eliminated. The only references to other publications are to those issued by recognized national associations organized for research and testing, such as the American Society for Testing Materials and the American Association of State Highway Officials.

By such references, the necessity of including long specifications has been avoided. Our district offices have been furnished with the latest volumes of the American Society for Testing Materials and the American Association of State Highway Officials, and material men and contractors are advised to purchase these books to complete the necessary references.

SOME STRIKING CHANGES

The volumes issued by these organizations are not available to outsiders through the State Division of Highways. The Standard Specifications of the American Society for Testing Materials can be purchased directly from that society located at 260 South Broad Street, Philadelphia, Pennsylvania; and the specifications for highway materials of the American Association of State Highway Officials can be purchased from that organization at 1220 National Press Building, Washington, D. C.

No definite attempt is made to describe all of the changes in the new 1940 edition because everyone concerned should become familiar with this book, and by so doing, will realize the differences. The most striking changes, however, involve the adoption of the U. S. square testing sieves for analyzing aggregates instead of the older types with round openings; the adoption of working days for determining the time limit of contracts; the inclusion of new specifications for paving asphalts and liquid asphalts; and complete new grading analyses for the various aggregates.

None of the older sections has been omitted and no new sections have been added.

Ten thousand copies of the last edition were printed, and since these specifications were put into effect last November, nearly half of this number has been distributed. The distribution includes not only the members of the California Division of Highways, but also the cities and counties of California, contractors, material men, producers of highway equipment, and also the States of the Union. Quite a number of copies have been forwarded to Mexico and South American countries. Many of the counties and cities of California who do not have specifications of their own, adopt the State Standard Specifications for their use. We are informed that the Territory of Hawaii has also adopted these as standards.

New methods of construction are constantly being developed, and new types of materials are being produced, requiring revisions in the methods of tests and inspection. As a result of these factors, it is difficult to establish definite standards which can be maintained without modification over a period of years. The necessary changes and modifications are made from time to time in the contract special provisions, thus providing the opportunity for proving the value of such changes on various contracts before they are adopted into the next issue of the Standard Specifications.

It is anticipated that the new edition of the Standard Specifications will remain in effect for several years before it is revised and republished.

Maintenance Engineers Discuss Their Problems

DISTRICT Maintenance Engineers and their assistants from the 11 Highway Districts in the State met with T. H. Dennis, Maintenance Engineer, and his Central Office assistants on February 17, 18 and 19 at Sacramento.

The bringing together of these engineers resulted in discussions of problems and procedure as it affected each district. Ideas were disseminated that provided answers to the other fellow's problems, as well as enlightened him as to findings or procedure elsewhere.

District VII provided interesting and constructive movies of Maintenance activities such as drainage corrections, comparisons of types and costs of loading equipment, pavement repairs and blanket surfacing, protection against erosion by pneumatic treatment, and traffic under both normal and abnormal conditions on the recently completed Arroyo Seco Freeway, between Los Angeles and Pasadena.

OTHER FEATURES EMPHASIZED

Director of Public Works Frank W. Clark and State Highway Engineer C. H. Purcell extended greetings from the Department.

Chas. Blood, Assistant City Engineer of Sacramento, presented a paper on an improved method, developed by him, of applying liquid asphalt into a pug mill for asphalt surface mixtures.

A. I. Rivett, Assistant Safety Engineer, spoke regarding personnel accidents and prevention. He stressed the importance of accurate and complete data for accident reports.

The program consisted of the following:

1. General discussion of personal problems, service agreements, expense accounts, etc. By J. G. Standley, Principal Assistant Highway Engineer. Related legal matters by Robert E. Reed.

2. Discussion of Maintenance accounting procedure, and proposed simplification for handling work orders, purchase orders, etc. By E. R. Higgins and A. H. Henderson.

3. General discussion on recent developments and use of various types of liquid asphalt, sampling, testing, etc. By F. N. Hveem.

METHODS AND PROBLEMS

4. Discussion of methods used and results obtained last season on seal coats, pavement blankets, types of oil, aggregate gradings, and methods conducive to securing improved results. Photographs were projected of surface textures and equipment on seal coats, non-skid surfaces and blanket jobs.

5. Discussion of legal problems. By Mr. Reed.
   (a) Procedure to follow for correction of drainage and seepage conditions from private property adjacent to the right of way.
   (b) Responsibility and procedure for correcting hazardous conditions resulting through operations of parties other than the Division of Highways.

6. Review of recent developments in subdrainage practice, using hydroauger equipment for slide and slipout correction. By O. J. Porter, supplemented with projected photographs and slides.

7. Equipment discussion with R. H. Stalnaker. State-owned versus rented equipment, etc.

New section of Cahuenga Pass looking north toward Barham overpass, showing two 4-lane highways separated by railroad tracks with ramps to service roads

Second Cahuenga Freeway Unit

By C. P. MONTGOMERY, Resident Engineer

WITH the completion of the second unit of its development as a Freeway, the Cahuenga Pass Highway, once a trail for Indian tribes of Southern California and the Franciscan padres of Father Junipero Serra, will enter the stage of final construction this summer.

Funds for its extension from Barham Road to Lankershim Boulevard in Los Angeles, which are provided for in the 1941-43 highway budget, will become available after July 1.

The first unit of this ultramodern highway project, constructed jointly by the Federal Government, the State and the City of Los Angeles, was opened to public traffic last June. It provided an eight-lane roadway separated by Pacific Electric tracks, an underpass at Highland Avenue, a pedestrian subway and overhead and the Mulholland Bridge.

Last December, the second unit carrying the Freeway from Mulholland Drive Bridge to Barham Road was completed. The third stage of construction will extend the new highway to Lankershim Boulevard.

The section finished last June was a little less than one mile in length; the second unit was 0.7 mile and the work to be started this summer will extend the highway about one mile.

Funds for contracts already completed were contributed as follows:

Federal Public Works Administration	$763,000
State Highway Funds, 1½-cent Gas Tax Funds	690,000
½-cent State Highway Gas Tax, City of Los Angeles	196,000
County of Los Angeles Funds	25,000
City of Los Angeles Funds	32,000
Total	$1,707,000

From the days when Los Angeles was a small pueblo, Cahuenga Pass has been a main artery of traffic, being the only pass through the Hollywood Hills which separate the San Fernando Valley and the coastal plain. In 1910, a two-lane pavement was laid through the pass. Increasing motor vehicle traffic compelled widening the highway. Nevertheless, Cahuenga Pass became one of the worst "bottlenecks" in Southern California. It became necessary to modernize the highway to meet traffic demands and the splendid Freeway of today is the result.

The original paving was of oil macadam. The grade was steep enough to challenge the driver of those days to negotiate the climb without changing gears, and several sharp curves served as a check to safe speed of cars after they had passed the summit. Incidentally, the first wreck on this grade occurred when a steam roller got out of control

At top—General view of new Cahuenga Pass Freeway section looking south. Mulholland Drive overhead structure in foreground spans the old pass road retained as a service road on the right, the two 4-lane freeway roads, depressed railroad tracks and service road on the left. Lower picture shows scene during construction when railroad tracks were moved to a center position between freeway lanes near the top of the grade and careened crazily down the pavement until it crashed into the cut bank half way down the hill.

As the Hollywood moving picture industry grew and the San Fernando Valley developed, the pavement which had been the source of so much pride in 1910 became inadequate to carry its increasing load. This section had become a part of the City of Los Angeles, and it was under the Engineering Department of the city that the pavement was rebuilt about 15 years ago.

The phenomenal growth on both sides of the pass, following this reconstruction, was responsible for the building, under the plans and supervision of the Engineering Department of the City of Los Angeles, of the Cahuenga Freeway. This Freeway was designed to collect and discharge the heavy flow of traffic to and from the converging streets at either end and carry it through the pass with the maximum speed and safety.

Traffic is carried on four-lane concrete roadways lined with concrete curbs and separated by the Pacific Electric railway. A long underpass serves as a grade separation for southbound traffic continuing on Cahuenga, while the two righthand lanes lead directly into Highland Avenue. Northbound traffic enters directly off Cahuenga Boulevard. At present the northern entrance to the Freeway is just north of Barham Road, directly from old Cahuenga Boulevard.

Concrete service roads allow access to the adjoining property and at Barham Road and above the Pilgrimage Bridge access to the Freeway.

Bridges span the Freeway, joining the service roads opposite the site of the Pilgrimage Play, at Mulholland Drive and Barham Road.

Access to and from the Pacific Electric railroad is provided by pedestrian tunnels under the Freeway just south of the Pilgrimage Bridge and north of the Mulholland Bridge.

The section of this Freeway from the Mulholland Bridge to Highland Avenue, including structures, was constructed under contract by J. E. Haddock, Ltd., Pasadena, and that section northerly from, and including the Mulholland Bridge, by Radich & Brown of Los Angeles. This construction was financed from State Highway and Quarter-Cent Funds in addition to a PWA grant from the Federal Government.

Three State-owned Bridges Report Steady Traffic Rise

A STEADY stream of traffic continued to flow across the three State-owned toll bridges throughout the month of February. The total for the San Francisco-Oakland Bay Bridge was 1,285,683 vehicles, or an average of 45,917 per day, representing an increase of 58 per cent over the daily average for the same month of the previous year.

At the Carquinez Bridge, the total traffic for the month was 258,352 vehicles which exceeds the record for February, 1940, by almost 80 per cent.

The Antioch Bridge, while carrying a much lighter traffic than either of the other bridges, showed, nevertheless, a substantial increase over the previous year.

The total traffic for February on the San Francisco-Oakland Bay Bridge and the Carquinez and Antioch bridges is tabulated below:

	San Francisco-Oakland Bay Br.	Carquinez Bridge	Antioch Bridge
Passenger autos and auto trailers	1,174,900	235,801	9,703
Motorcycles and tricars	2,393	427	7
Buses	22,849	4,152	174
Trucks and truck trailers	63,007	17,797	1,712
Others	22,534	175	10
Total vehicles	1,285,683	258,352	11,606

Sponsored by the State and conducted by the Works Progress Administration an elaborate landscaping project looking to the beautification of this important entrance to Los Angeles is getting under way.

What Is a "Pleasure Car"?

During the early days of the automobile, passenger cars were called "pleasure cars." But that name no longer is descriptive, according to the U. S. Public Roads Administration. In a study of highway traffic in 25 States, the administration found that 55 per cent of passenger car mileage is used on business trips and that only 45 per cent is for purely recreational or social purposes. Farmers use their cars about two-thirds of the time for business. In the large cities use of passenger cars is approximately evenly divided between business and recreation.

It is estimated that one day's operation of a fleet of bombing and pursuit planes in Europe's mechanized forces necessitates the consumption of enough motor fuel to operate 3,000 American passengers cars for a full year.

A. R. B. A. Organizes Economics Service

The inauguration of a Highway Economics Division, the first "Highway Laboratory" of the nation, designed to gather and distribute information and data on highway construction and maintenance, is announced by the American Road Builders' Association.

"With the increasing need of more efficient highway programs throughout the country as an urgent factor in adequate national defense," says the announcement, "the ARBA executive committee and board of directors authorized the association's technicians to create a bureau long needed as a highway economics "clearing house" for the road-building profession and industry.

"The new division will be looked upon to aid in stabilizing road expenditures in accordance with fluctuating amounts of Federal funds, gas taxes and registration fees. It is believed by ARBA officials that more comprehensive State highway programs will result, if accurate, up-to-the-minute information of this nature is available."

Washout on U. S. 299 West of Redding caused by February storms. Large sections of pavement were destroyed by undermining waters

Storm Damage to State Highways $600,000

(Continued from page 2)

some extent, must disregard unfavorable topographical conditions. The present intensive preliminary investigations of underlying soil foundations and slope planes tend to reduce these necessary risks.

However, it is obviously uneconomical to construct every highway so that it would weather all storms. Such a policy would, if adopted, materially restrict the mileage of improved highways. It would likewise disregard the fact that hundreds of miles of highways as now built have suffered but nominal damage under the most severe storms.

There is one phase of storm damage, however, that demands early correction. I refer to the many locations on valley roads which are flooded each year, due to the blocking or elimination of former channels. It is imperative that adequate outlets be provided for this drainage, which now is a barrier on many of our main valley roads to civil traffic, and will in times of need seriously affect all military transport as well.

Why women are like newspapers: There is a bold face type, back numbers are not in demand, they have a great deal of influence, every man should have one of his own and not chase after his neighbor's.

Bomb Shelter on Property State Buys

Indicative of the trend in world affairs is a situation reported to the State Division of Highways by one of its Right of Way Agents in Los Angeles.

In a report to the Department of Public Works, the Right of Way Agent, who is engaged in obtaining property over which a highway improvement is to be made, writes:

"In addition to the concrete walls, the owner recently has installed a reinforced concrete bomb-proof shelter that was dug out of the sandstone hill. He is the first landowner I have run across who is prepared for the worst."

QUESTION OF TIMING

"I won't get married until I find a girl like Grandpa married."

"Huh! They don't make them like that these days."

"That's funny. He only married her yesterday."

ONE MORE

"The bravest man I ever knew," said the explorer, "was the chap who took a taxi to the bankruptcy court, and then, instead of paying his fare, invited the driver in as a creditor."

Cement Stabilized Base Used in 4-Lane Job

(Continued from page 19)

laminations and were eliminated from this operation. This was overcome by truck rolling, using pneumatic tires and a slight excess of moisture on the surface.

When laminations could not be eliminated by rolling, the high parts were cut off with a motor grader and wasted.

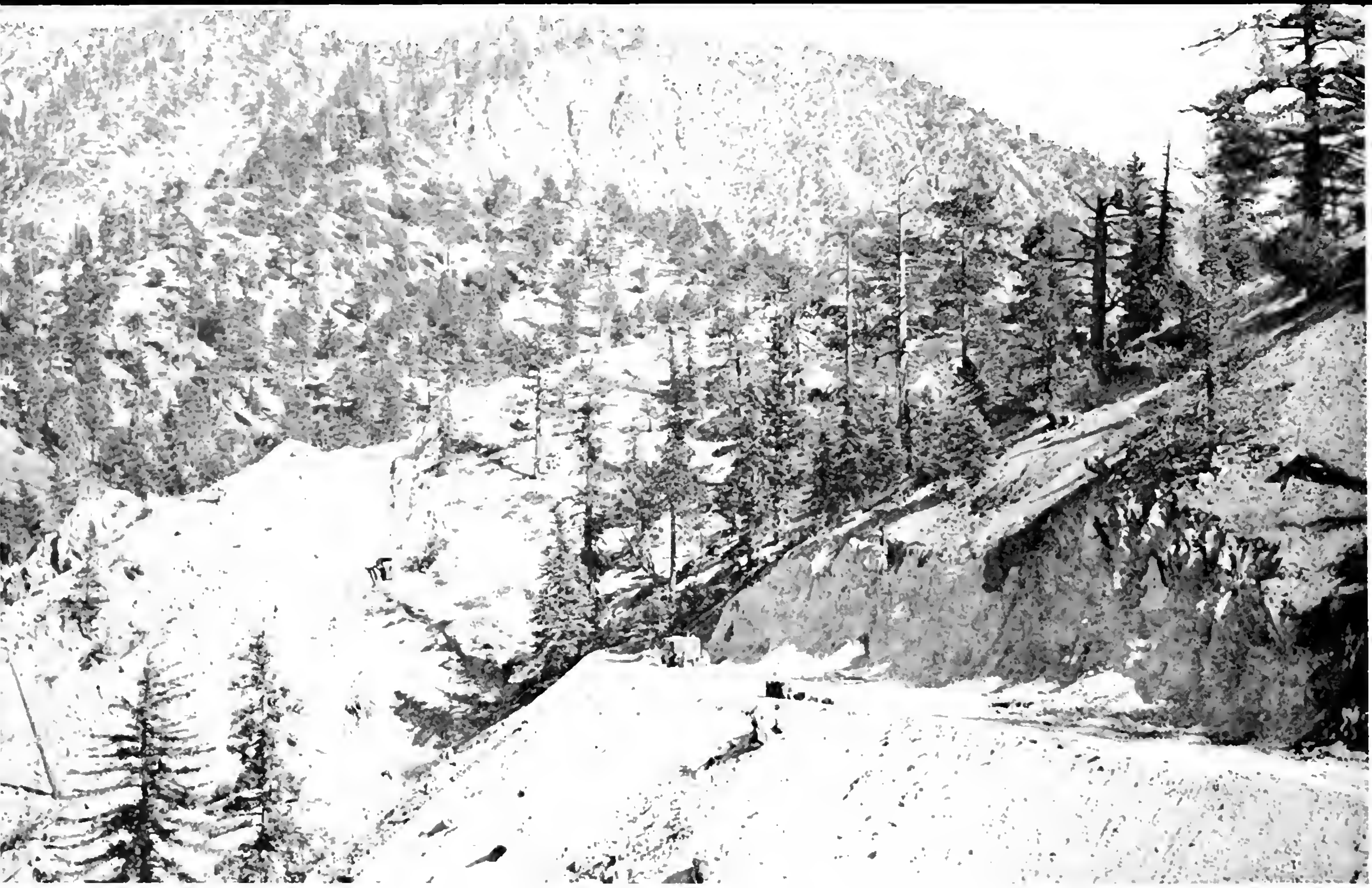
CURING SEAL APPLIED

Immediately behind the final rolling, an application of approximately $\frac{1}{4}$-gallon per square yard of Liquid Asphalt RC-1 was applied, as a curing seal, using a power spray and hand operated nozzle.

At the beginning, the time cycle required in handling the mixture from the mixing plant to the finish rolling on the street was about three hours. As equipment and handling technique were developed, this was reduced to about $1\frac{3}{4}$ hours.

Recent experience on other projects shows that individual characteristics develop for different jobs regarding compressive strength, water control, and bulking when spread on street and difficulties encountered in consolidating and compacting.

The work is being done by Oswald Brothers, contractors. J. M. Hollister is the resident engineer.



Scene at end of present grading operations on Angeles Crest Highway showing mountainous terrain ahead to be penetrated by tunnels

Two Mountain Tunnels Necessary On the Angeles Crest Highway

By J. M. LACKEY, Asst. District Construction Engineer

TO THE north of Los Angeles an east and west range, known as the San Gabriel Mountains, forms a rugged barrier through which Angeles Crest Highway (Route 61) will be, upon completion, the only break in the 98 miles between Fremont Pass and Cajon Pass.

This scenic mountain highway, approximately 55 miles in length, extends from La Canada to Big Pines County Park and connects with the San Bernardino County portion of Route 61. Grading and surfacing have been completed from La Canada to Cedar Springs, a distance of 37 miles.

Throughout its length the highway will pass through rugged mountains and, with the exception of the first two miles, is entirely within the Angeles National Forest, which is being maintained as a recreational area free of commercial establishments and residential buildings.

Development of roads and recreational facilities in these mountains has been slow, due to insufficient funds for the heavy construction necessary in a country which "stands on end." This route serves principally as a scenic drive and access road to a vast recreational area, important to the three million people living in the metropolitan area immediately to the south.

Several branch roads have been completed and are in use. From Red Box an excellent paved highway leads to the Mt. Wilson Observatory. Another road, leading from the same junction, serves resorts in the canyon of the West Fork of San Gabriel, and starting at Switzer's Saddle a county highway to the north forms a connecting link with the Mint Canyon Route (Route 23) and Antelope Valley.

West Islip Saddle, which will be a landmark on the new highway, will also be the northerly terminus of San Gabriel Canyon Road (Route 62), now open from Azusa on Foothill

(Continued on page 31)

The above pictures are typical views of the heavy construction necessary on State Route 61, the Angeles Crest Highway through a rugged mountain section of Angeles National Forest in Los Angeles County where a 30-foot graded roadway is being built

Mountain Tunnels Necessary on Angeles Crest Highway

(Continued from page 28)

Boulevard to Crystal Lake, leaving but four miles of construction to complete the connection. Completion of this connection and the project now under way on the Angeles Crest Highway will provide a scenic circular trip via Angeles Crest Highway, San Gabriel Canyon Highway and Foothill Boulevard.

The Cloudburst Summit area, 35 miles from La Canada, reaches an altitude of nearly 7,000 feet, and is now available for winter recreational purposes and thousands of cars pack the highway during week ends. However, this territory is at present generally too rugged for snow sports and much fine snow country on the higher ridges remains inaccessible, awaiting the construction of forest roads and trails by the National Forest Service.

The men from the CCC Camp at Chilao Flats have for several years been engaged in building forest roads, trails and camp sites and facilities for a limited number of people are now available. However, much work remains to be done before all of the recreational potentialities are developed.

SNOW SPORTS COUNTRY

Regarding the fine snow country mentioned above, the higher ridges are snow clad for three to four months each season and on their more gentle slopes facilities may be developed for thousands of winter sport enthusiasts.

Many trails have been constructed for hikers along the first 15 miles of the route and many more are possible. Camp grounds and picnic sites are not so easily developed due to scarcity of water.

Control of forest and brush fires, the most important work in flood control, has been greatly aided by the construction of this road. Transportation of men and equipment between distant points has been greatly speeded up.

Maintenance forces have had many problems to solve. Flash storms, summer and winter, tax drainage systems to the limit and often more. Sanding icy pavements is an almost continuous winter chore and snow removal a major operation.

Fires, caused by lightning and careless smokers, occur all too frequently, causing increased run-off of debris laden storm water which adds to the complications.

MOST DIFFICULT SECTION

Location and construction problems in building this highway have been numerous and difficult. Much of the country will remain almost inaccessible, even to surveyors, until trails are constructed. Many sections of the roadbed must be excavated entirely in solid ground because of the steepness of the mountain slopes.

Now under construction is a 3.07 mile section from Cedar Springs to West Islip Saddle. This is probably the most difficult part of the entire route. There is very little soil and 80 per cent of the excavation must be blasted. Due to the steepness of the slopes, the fills must be held by retaining walls where the road crosses ravines. In keeping with the surroundings, rubble masonry is used for walls, drainage structures, spillways, paved channels, etc.

Near West Islip Saddle the country becomes so rugged that tunnels must be resorted to. Two inclined ridges, projecting from the face of Mt. Williamson, are too steep even for pioneer roads and two tunnels will be required; one 640 feet in length and one 460 feet, with an interval of 120 feet between portals. Construction must start at the first portal, because of the difficult terrain, and the entire work on the two tunnels done from one end.

TUNNEL CONSTRUCTION PLANS

Three of the four portal locations are on nearly perpendicular rock faces, 50 to 75 feet above the canyon floor, making it necessary to construct earth ramps before starting excavation. A pilot bore approximately 9 x 9 feet in size will be driven for the first tunnel, principally for ventilation and exploration. The pilot for the second tunnel will be 9 x 14 feet so that after completion of the first tunnel tractor bulldozers and other equipment may be passed through for pioneer work on the remaining portion of the line to Islip Saddle. The completed tunnel, a horseshoe type arch, will be lined with reinforced concrete throughout. The opening will be 32 feet wide by 20½ feet high. Portals will be constructed of rough stone.

Rock for concrete will be produced by crushing material taken from the tunnels. This is necessary because of the long, expensive haul over the mountain roads from commercial rock plants 60 to 70 miles distant. Finances will not permit the comple-

How Motor Has Replaced Army Mule

Pointing out that in the conquest of France and the Low Countries all German supplies were carried by motor, Brig. Gen. J. E. Barzynski of the U. S. Quartermaster Corps at the annual convention of the National Automotive Dealers Association in Pittsburgh emphasized the important role that motor transportation will play in the national defense program.

"A fast and reliable system of motor movement was a vitally important factor in the German conquest," he said. "Activity in the repairs of wrecked railroads was not even attempted during the early stages of this conflict. Without motor vehicles carrying troops and supplies, the word blitzkreig would hardly have its present meaning in the world today."

That the motor vehicle has replaced the famous army mule was indicated by Gen. Barzynski, who asserted that the field army of 1,400,000 men would need approximately 250,000 vehicles, that today there are 70,000 motor vehicles in service and by the latter part of April, there will be 140,000, and by the end of the fiscal year 190,000 representing an increase of almost seventeen times the number of motor vehicles in army service four years ago.

tion of this highway for several years. therefore, it is possible to proceed with tunnel construction at a moderate schedule, permitting a large saving in equipment cost, usually a major item in tunnel construction. It is estimated that all work on the bores will be completed in 13 or 14 months.

TWO YEARS TO COMPLETE

Cost of this 3.07 mile project, including tunnels, will be in excess of $700,000 and will require over two years to complete. Grading on the first two miles from the southwesterly end of the job to the tunnel is over 50 per cent completed. Work on the third mile can not be started until equipment can be moved through the tunnels.

From West Islip Saddle the line runs along the northerly side of Mt. Islip and North Baldy Peak, following northerly mountain slopes with the Mojave Desert almost constantly in view. The grade will be slightly rolling, varying from 6,500 to 7,500 feet above sea level. The entire distance is through timbered country and on very steep slopes. Construction will be difficult and expensive and it will be several years before sufficient funds are available to complete the road to Big Pines.

Relationship of Road Officials to Defense

(Continued from page 21)

"The happiest personal reaction which I obtain from this great National undertaking, in which all of the States are participating with the Public Roads Administration, is found in the attitude I meet among the officials of the Highway Departments of professional sureness and confidence in their knowledge of the highway needs of their States, and the relative priorities of these needs.

"Thus, in the only way possible, the ideals of impartial and efficient service to the public have been lifted out of reach of selfish motives of both individuals and groups to a degree never before attained. The Highway Departments have now the facts, first to guide decisions, and second to support their decisions successfully before the all-important court of public opinion."

In Memoriam

Lester T. Harbey

Lester T. Harbey, Highway Maintenance Foreman on the San Francisco-Oakland Bay Bridge, passed away January 11, 1941, in Oakland, California.

Mr. Harbey was born November 21, 1896, in Colorado, Texas, later moving to El Paso where he attended the Bell Grammar School and Lamar High School.

In May, 1916, he enlisted in the U. S. Army and served with General Pershing in the Mexican Expedition and overseas after the United States entered the World War. He received his honorable discharge in June, 1919. He went into business for himself from 1919 to 1926 when he entered the employ of the J. E. French Company in Oakland.

He entered State service in the Department of Public Works, Division of Highways, in February, 1928, serving as Highway Maintenance Foreman in District III at Woodland, Williams and Courtland stations until November, 1936, when he transferred to the San Francisco-Oakland Bay Bridge and served in the same capacity until his untimely death.

Mr. Harbey was a member of Marfa Lodge No. 596, A. F. and A. M. of Texas, and of the American Legion and Veterans of Foreign Wars. He was very active in C. S. E. A. affairs, joining the organization's Sacramento Chapter and later transferring to Bay Bridge Chapter No. 49 where he served as its president in 1938 and as regional director of District VI during 1940.

He is survived by his wife and a son, Douglas, and two brothers, Charles T. and George A. Harbey, and two sisters, Mrs. Rose E. Jones and Mrs. Englebright.

In his passing, the employees of the Bay Bridge have lost a true and trusted friend, whose chief concern was for the welfare of his fellow workers. The entire organization extends to his widow, his son, and relatives their deepest sympathy and consolation.

Motor Vehicle Peak Year

Motor vehicle production for the United States and Canada reached a peak in 1929 when 5,621,045 vehicles came off the assembly lines. The next highest year, according to the Automobile Club of Southern California, was 1937 when 5,016,437 vehicles were produced.

Teacher: "Now, Class, if you take five from eight, what's the difference?"

Voice from Back Row: "That's what I say. Who cares?"

Two Executives Of Public Works Rejoin U. S. Army

BRINGING to a total of forty-two the employees of the Department of Public Works who have been called into military service Colonel Edward Jackson Murray, Assistant Bridge Engineer of the Division of Highways, and Captain George T. Gunston of the Division of Water Resources resumed active army duty on February 21st.

Colonel Murray is commanding officer of the 184th Infantry, California National Guard, and Captain Gunston is on the staff of Colonel Otto Sandman, 143d Field Artillery. Colonel Murray's outfit will encamp at the State Fair Grounds in Sacramento until March 15th, when it will go to San Luis Obispo. Captain Gunston will also go to San Luis Obispo.

ROSE FROM PRIVATE

Enlisting as a private in Co. G, 2d Infantry, National Guard on April 25, 1914, Colonel Murray attained the rank of Second Lieutenant, saw service on the Mexican border in 1916 and in September, 1917, went overseas as First Lieutenant, Co. G, 160th Inf. Following the war he was commissioned Captain in the National Guard and assigned to the 184th Inf., which he now commands. He entered State service with the Division of Highways on April 1, 1924.

When it appeared the United States would enter the last World War, Captain Gunston enlisted in the Washington National Guard in February, 1917. He was sworn into Federal service in June of that year and later was commissioned as Second Lieutenant. Discharged in December, 1918, Captain Gunston came to California, attended the University of California 1919-1920 and then transferred to the University of Washington.

From 1923 to 1926, Mr. Gunston was a Second Lieutenant, Finance Reserve. On June 14, 1926, he was commissioned First Lieutenant, Field Artillery, California National Guard and later was given command of Battery D, 143d Field Artillery.

(Continued on page 32)

Highway Bids and Awards for February 1941

ALAMEDA AND CONTRA COSTA COUNTIES—Diesel oil to be applied to roadside vegetation for about 78 roadside miles. District IV, various locations. Hayward Building Material Co., Hayward, $2,240; Lee J. Immel, Berkeley, $2,348. Contract awarded to Pacific Truck Service, Inc., San Jose, $1,920.

KERN COUNTY—Two bridges to be constructed at Bakersfield, one across Kern River, having a length of 630 feet, and one across Kern River Overflow, having a length of 100 feet. District VI, Route 58, Section L. A. Teichert & Son, Inc., Sacramento, $96,366; Trewhitt-Shields & Fisher, Fresno, $99,975; Werner & Webb, Los Angeles, $102,363; Griffith Co., Los Angeles, $104,077; Louis Biasotti & Son, Stockton, $108,312; A. Soda & Son, Oakland, $109,792; Martin & Schmidt Contractors, Long Beach, $114,849; Carlo Bongiovanni, Los Angeles, $122,999. Contract awarded to F. Fredenberg, South San Francisco, $96,253.

MARIN, NAPA, SONOMA COUNTIES—Diesel oil to be applied to roadside vegetation for about 174 roadside miles. District IV, various locations. Edward A. Forde, San Anselmo, $5,359; Close Building Supply, Hayward, $5,359; Kuppinger and Pinkham, Lakeport, $5,681; Lee J. Immel, Berkeley, $5,704. Contract awarded to Pacific Truck Service, Inc., San Jose, $4,669.

MERCED AND MARIPOSA COUNTIES—Furnishing and applying diesel oil to 121.6 miles of roadside vegetation. District X, various locations. Pacific Truck Service, Inc., San Jose, $2,166; Claude C. Wood, Lodi, $2,080; Sheldon Oil Co., Suisun, $2,175. Contract awarded to Close Building Supply, Hayward, $2,042.

SACRAMENTO AND CONTRA COSTA COUNTIES—At San Joaquin River about five miles north of Antioch, bridge fenders and dolphins to be repaired. District X, Route 11, Sections C and A. Bundesen & Lauritzen, Pittsburg, $37,451; E. G. Perham, Los Angeles, $43,292; Kiss Crane Service, Berkeley, $41,217. Contract awarded to M. A. Jenkins, Sacramento, $26,976.

SAN JOAQUIN COUNTY—Moving tender's cottage from Garwood Ferry Bridge to Potato Slough Bridge. District X, Route 75, 53, Sections A, C. H. W. Johnson, Stockton, $1,185; J. R. Estes, W. Sacramento, $992. Contract awarded to J. E. Fitzsimmons, Lodi, $990.

SOLANO, SAN JOAQUIN, CALAVERAS AND AMADOR COUNTIES—Furnishing and applying diesel oil to 141.2 miles of roadside vegetation. District X, various locations. Pacific Truck Service, Inc., San Jose, $2,854; Close Building Supply, Hayward, $2,700. Contract awarded to Sheldon Oil Co., Suisun, $2,406.

Bids and Awards for Jan., 1941

SACRAMENTO AND SAN JOAQUIN COUNTIES—Across the Mokelumne River about 5 miles west of Terminous, a steel truss swing bridge with 55 timber stringer and 2 steel stringer approach spans to be constructed and at the west approach to Little Potato Slough crossing at Terminous, a timber stringer ramp trestle to be constructed. District X, Route 53, Section C. C. Heafey-Moore Co. & Fredrickson & Watson Construction Co., Oakland, $361,643; A. Soda & Son, Oakland, $379,598; Ralph A. Bell, San Marino, $392,235; C. W. Caletti & Co., San Rafael, $111,575. Contract awarded to Tavares Construction Co., Inc., Los Angeles, $350,559.

SAN LUIS OBISPO COUNTY—At Toro Creek and at Old Creek, two reinforced concrete bridges to be constructed and about 1.6 miles of roadway to be graded and bituminous surface treatment applied. District V, Route 56, Sections D, C. Claude C. Wood & L. D. Tonn, Lodi, $116,630; Piazza & Huntley and Trewhitt-Shields & Fisher, San Jose, $118,273; Gibbons & Reed Co., Burbank, $133,296; Ralph A. Bell, San Marino, $151,366; J. E. Haddock, Ltd., Pasadena, $153,152. Contract awarded to F. H. Gates, Santa Maria, $109,017.

TUOLUMNE COUNTY—Between one mile south of Jamestown and Jamestown, about one mile to be graded and surfaced with road-mixed surfacing on gravel base. District X, Route 13, Section B. Louis Biasotti & Son, Stockton, $55,591; Johnston Rock Co., Inc., Stockton, $57,632; Frederickson Bros., Emeryville, $63,672; Heafey-Moore Co. & Frederickson & Watson Construction Co., Oakland, $65,205; Poulos & McEwen, Sacramento, $69,507; Scheumann & Johnson, Eureka, $71,673. Contract awarded to Dan Caputo, San Jose, $50,145.

VENTURA AND LOS ANGELES COUNTIES—Between Piru Creek and Los Angeles County line, about 5.7 miles to be graded and Portland cement concrete pavement and plant-mix surfacing to be placed. District VII, Route 79, Sections C, A. Oswald Bros., Los Angeles, $279,928; Matich Bros., Elsinore, $292,631; Griffith Co., Los Angeles, $296,085; J. E. Haddock, Ltd., Pasadena, $296,711; Clyde W. Wood, Los Angeles, $296,724; Radich & Brown, Burbank, $332,814; Ralph A. Bell, San Marino, $336,363. Contract awarded to Fredericksen & Westbrook, Sacramento, $256,033.

In Memoriam

Major Glenn H. Stough

Major Glenn H. Stough, 50, assistant hydraulic engineer in the Division of Water Resources, Department of Public Works, passed away at the Sacramento Emergency Hospital January 26, 1941, as the result of a heart attack.

Major Stough had been at work the day previous to his passing. Early the next morning he was stricken with a heart attack at his home at 2417 U Street and died en route to the hospital.

He was born in Woodson County, Kansas, December 15, 1890. He attended public schools in Chicago, graduated in engineering from the University of Illinois in 1913. He was a member of the Triangle Club and Tau Beta Pi, honorary engineering socety.

In 1914 he joined the Illinois National Guard and entered active service with the guard in 1916 when it was sent to the Mexican border, at which time he applied for a reserve commission in the Engineer Corps. He attended the First Officers Training Camp and was commissioned a first lieutenant in the Engineer Corps with the Coast Artillery.

During the World War Lieut. Stough on active service rose to the rank of major, and following the war served with the U. S. Army Engineer Corps until his retirement in 1934.

Major Stough joined the staff of the Division of Water Resources in 1938 as assistant hydraulic engineer and was in charge of flood damage repair work in Siskiyou, Shasta, Trinity and Tehama counties. Recently he was working on flood damage repairs on the Van Duezen, Klamath, Eel and Mad rivers in Humboldt and Del Norte counties.

Military funeral services were held in the Presidio and interment took place in the San Francisco National Cemetery at the Presidio on January 29th.

He is survived by his wife, Mrs. Grace Lynch Stough; a daughter, Morgia Jane; two sons, Glenn H., Jr., and James McKenzie Stough, and a sister, Mrs. E. D. Goodell of Newport Beach.

International Highway Completion Urged

Executives of 14 motorists' organizations attending the recent Western Conference of Automobile Clubs in Reno strongly indorsed the International Pacific Highway project. A resolution urging completion of the highway which contemplates connecting north-south routes in western United States with Alaska and with Central and South America was adopted unanimously.

The resolution declared: "Because of its economic value, its contribution to National defense, and its social significance, we, the Western Conference of Automobile Clubs, indorse the International Pacific Highway, and urge the American Automobile Association, National headquarters, and other interested organizations to continue their efforts to procure Congressional help in advancing this enterprise."

Two Executives of Public Works Rejoin U. S. Army

(Continued from page 31)

Captain Gunston entered the employ of the State on September 5, 1922, as Personnel Clerk and Assistant Secretary of the California Highway Commission. In July, 1923, he was appointed Disbursing Officer of the Department of Public Works and on October 26, 1937, was promoted to the post of Administrative Officer to Edward Hyatt, State Engineer.

Both Colonel Murray and Captain Gunston have been granted leaves of absence for the duration of the present emergency.

State of California

CULBERT L. OLSON, Governor

Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

FRANK W. CLARK, Director of Public Works

FRANZ R. SACHSE, Assistant Director

MORGAN KEATON, Deputy Director

CALIFORNIA HIGHWAY COMMISSION

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DISTRICT ENGINEERS

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CHARLES H. WHITMORE, District III, Marysville
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SAN FRANCISCO-OAKLAND BAY BRIDGE

RALPH A. TUDOR, Principal Bridge Engineer, Maintenance and Operation

DIVISION OF WATER RESOURCES

EDWARD HYATT, State Engineer, Chief of Division
GEORGE T. GUNSTON, Administrative Assistant
HAROLD CONKLING, Deputy in Charge Water Rights
A. D. EDMONSTON, Deputy in Charge Water Resources Investigation
GEORGE W. HAWLEY, Deputy in Charge Dams
SPENCER BURROUGHS, Attorney
GORDON ZANDER, Adjudication, Water Distribution

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W. K. DANIELS, Assistant State Architect
P. T. POAGE, Assistant State Architect

HEADQUARTERS

H. W. DeHAVEN, Supervising Architectural Draftsman
C. H. KROMER, Principal Structural Engineer
CARLETON PIERSON, Supervising Specification Writer
J. W. DUTTON, Principal Engineer, General Construction
W. H. ROCKINGHAM, Principal Mechanical and Electrical Engineer
C. E. BERG, Supervising Estimator of Building Construction

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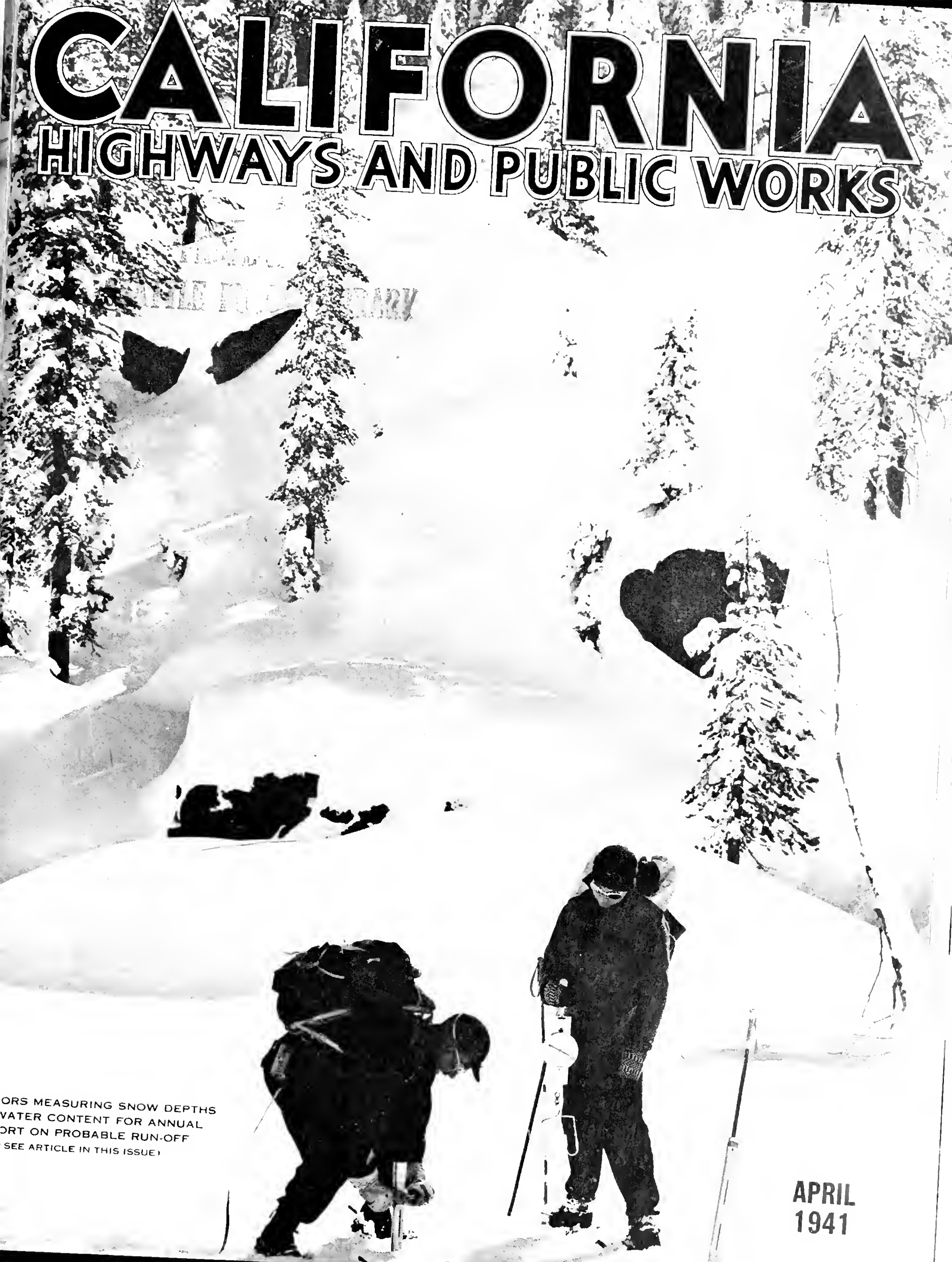

ORS MEASURING SNOW DEPTHS
VATER CONTENT FOR ANNUAL
ORT ON PROBABLE RUN-OFF
(SEE ARTICLE IN THIS ISSUE)

APRIL
1941

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California

FRANK W. CLARK, Director C. H. PURCELL, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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Vol. 19 APRIL, 1941 No. 4

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Highway Commission Dedicates Three New Bridges on National Defense Highway System

THREE new highway bridges on U. S. 101, two in Humboldt County and one in Del Norte County, which meet all structural requirements of the War Department, have become available for National defense purposes.

The spans were dedicated during a two-day celebration on March 27-28. The Humboldt bridges will replace old, narrow, dangerous structures across the Eel River at North Scotia and at Robinson Ferry, one and one-half miles north of Scotia. The new Del Norte bridge crosses the Smith River north of Crescent City and takes the place of a span that has outlived its usefulness.

The three bridges while built primarily to supplant posted structures which have long been considered hazardous by the Division of Highways are of increasing importance at this time because they are located on the Redwood Highway, designated by the War Department as a link in the strategic network of military roads in California.

OLD BRIDGES OBSOLETE

Although adequate for the traffic of their day, the old bridges are too narrow for modern traffic needs and beyond rebuilding. The trio of new structures cost $1,128,898 representing State and Federal Aid funds.

Approach highway work and painting on the Robinson Ferry bridge was completed the middle of this month and the North Scotia span will be wholly completed next July. The Smith River structure is open to traffic.

Colorful dedicatory ceremonies were held at Scotia on Thursday afternoon, March 27th and at the Smith River bridge on the afternoon of the following day. In order to participate in the festivities, the California Highway Commission, headed by Chairman Larry Barrett of San Francisco, held its regular monthly meeting in Eureka on the morning of March 28th.

Bridge Statistics

ROBINSON FERRY BRIDGE

Cost	$480,000
Length	1,604 feet
Roadway width	26 feet
Alloy steel used	2,520,000 pounds
Bar reinforcing steel used	945,000 pounds
Concrete used	7,500 cubic yards

NORTH SCOTIA BRIDGE

Cost	$348,000
Length	1,137 feet
Roadway width	26 feet
Alloy steel used	1,950,000 pounds
Bar reinforcing steel used	680,000 pounds
Concrete used	4,735 cubic yards

SMITH RIVER BRIDGE

Cost	$243,225
Length	1,050 feet
Roadway width	26 feet
Structural steel used	1,065,000 pounds
Bar reinforcing steel used	625,800 pounds
Concrete used	2,500 cubic yards

CIVIC BODIES COOPERATE

Arrangements for the dedications were made by Clyde Edmondson, general manager of the Redwood Empire Association, with the cooperation of the boards of supervisors of Humboldt and Del Norte Counties, the Humboldt County Board of Trade, the Chambers of Commerce of Eureka, Smith River and Crescent City, and the Pacific Lumber Company of Scotia, which closed its huge mills for a half day on March 27th.

A crowd in excess of 1,500 persons witnessed a parade and heard a program of speeches at Scotia which preceded dedicatory ceremonies held at the southern approaches to the North Scotia and Robinson Ferry bridges in which the five members of the Highway Commision, State and county officials and officers of the Redwood Empire Association participated.

The Scotia band, the Fortuna band, and the a cappella choir of the Fortuna high school led a caravan of automobiles from the Mowatoc Hotel to the speakers platform at the south bridgehead of the North Scotia span. Acting as master of ceremonies, George G. Cloney introduced the following speakers:

NOTABLES IN ATTENDANCE

C. H. Demaray of Grants Pass, Oregon, president of the Redwood Empire Association; Clifford Bartlett, Marin County; Chairman George Cole of the Humboldt Board of Supervisors; Paul E. Mudgett, president Humboldt County Board of Trade and chairman of the Committee on Arrangements; Ed Haehl, chairman Mendocino Board of Supervisors; Elmer P. McKenzie, Scotia; Supervisor John Ratto, San Francisco; M. Goldman, Sonoma County, chairman of the Nine-Counties Highways Committee; Highway Commissioners L. G. Hitchcock, Santa Rosa; Iener W. Nielsen, Fresno; Amerigo Bozzani, Los Angeles; Bert Vaughn, Jacumba; Chairman Barrett; Morgan Keaton, Deputy Public Works Director, representing Governor Culbert L. Olson, and Director of Public Works Frank W. Clark.

Voicing the appreciation of the nine counties of the Redwood Empire, General Chairman Bartlett said:

"All of us are deeply grateful to the chairman and members of the California Highway Commission, the State Director of Public Works, the State Highway Engineer and their associates and staffs for these two new beautiful and modern bridges—this one in Scotia and the Robinson Ferry bridge north of here. We are also indebted to the United States

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View of crowd at dedication of North Scotia Bridge shown in background with old span parelleling it

Public Roads Administration for Federal Aid funds.

IMPORTANT TO NATIONAL DEFENSE

"We are gathered here today to publicly honor these officials and to thank them for bringing to completion two more important projects so vital not only to the Redwood Empire, but to the State Highway System and the highways of the West and of the Nation. These bridges represent an important link in the Pacific Coast interstate system and are not only vital to the free, safe and dependable movement of tourist and commercial peace time traffic but also to National defense."

Chairman Barrett of the Highway Commission described the engineering featres of the two bridges and added:

"One of the greatest scenic assets of the State of California is the Redwood Highway. The Highway Commission is fully cognizant of the value of this highway and in the preparation of budgets the policy of the commission is to do all that is possible, with the funds that are available, towards the improvement of this and other highways throughout the scenic areas of California."

COLORFUL OPENING CEREMONY

At the conclusion of the speech making, Chairman Barrett led the official delegation to a barrier of redwood logs and greens stretched across the North Scotia bridge approach. At a signal from E. E. Yoder, General Manager of the Pacific Lumber Company, seven attractive Fortuna high school girls in sports costumes, swung the barrier open and Barrett, the other highway commissioners and State and county officials marched onto the span.

The girls, who added color to the occasion, were Phyllis Ingraham, Florence Willburn, Nita Murrish, Joyce Simmons, Julia O'Connor, Patricia Skiffington and Lorraine Zimmerman.

Following this ceremony, the official party entered cars and led a long caravan of automobiles over the new bridge to the Robinson Ferry bridge where brief dedicatory ceremonies were held.

The organizations which staged the celebration later tendered a dinner in the Mowatoc Hotel in Scotia to visiting officials and guests.

At the conclusion of their meeting on Friday morning, March 28th, the members of the Highway Commission and visiting officials were guests at a luncheon in the Eureka Inn tendered by the Humboldt County Board of Trade and the Eureka Chamber of Commerce following which they motored to the new Smith River bridge, 9½ miles north of Crescent City. Here dedicatory ceremonies were held in which men and women of the Klamath Tribe of Indians in full regalia and the Crescent City High School Band participated.

SMITH RIVER BRIDGE DEDICATED

President Demaray of the Redwood Empire Association, introduced by Vance Bolick of Smith River, initiated the speech making. In addition to the speakers who had appeared on the program at Scotia, the following were introduced for short talks: J. J. McNamara, chairman of the Board of Supervisors of Del Norte; Chairman Warren Shannon of the San Francisco Board of Supervisors; Clarence Westbrook, president, Del Norte Chamber of Commerce; Supervisor Ira L. Scott, representing Smith River Chamber of Commerce, and Joseph Oliver, president, Crescent

City Chamber of Commerce.

Following the address, the Indians and a group of Del Norte girls formed in two lines across the center of the bridge. Chairman Barrett then led his fellow commissioners and members of the official delegation through the "human barrier" and the Smith River bridge was officially dedicated to public traffic.

Later a buffet supper was served at the Oregon line with Supervisor McNamara and his board and the Chambers of Commerce of Crescent City and Smith River and the Chamber of Commerce of Del Norte acting as hosts.

Two years ago, in adoption of the State highway budget for the current biennium, the members of the Highway Commission selected as necessary improvements to the Redwood Highway, U. S. 101, the construction of several major bridges designed to forestall the possibility of bottlenecks restricting traffic flow over this popular route through the redwoods.

Included among these major structures were the bridges for the two crossings of the Eel River on both sides of Rio Dell, north of Scotia.

The Robinson Ferry bridge is the larger of these two structures across the Eel River, and is one of the most modern bridges on the State Highway System. Its overall length is 1,604 feet and, structurally, the bridge consists of three 300-foot steel truss spans, 12 reinforced concrete girder spans, totaling 676 feet, and two reinforced concrete cantilever spans of 12 and 16 feet respectively.

The massive structure shown above replaces unsafe Robinson Ferry Bridge across Eel River pictured below, posted for load limit

The spans are supported on reinforced concrete piers and bents. The roadway width of the concrete deck is 26 feet between curbs and the two sidewalks are each 4 feet in width.

NEW ALLOY STEEL USED

In the construction of both the Robinson Ferry bridge and the North Scotia bridge, Division of Highways Bridge Engineers effected considerable economy by the use of new and more scientific materials. The steel used in the large trusses of these bridges is a new structural alloy steel that has a strength one and one-half times that of ordinary structural steel and which is also much more rust-resistant. These factors mean economy in both construction and maintenance costs.

Approximately 2,520,000 pounds of this new structural alloy steel has gone into the trusses of the Robinson Ferry bridge. There are nearly 7,500 cubic yards of portland cement concrete and 915,000 pounds of bar reinforcing steel in the girders, piers, bents, and floor, and some 300 piles were driven for foundations of piers and bents.

$180,000 CONTRACT

The contract for the construction of this new crossing of the Eel was awarded by Frank W. Clark, Director of Public Works, on February 5, 1940, to the Engineers, Ltd., of San Francisco. The project has been financed by Federal Aid and State highway funds at a cost of about $180,000.

The North Scotia bridge is practically complete and is likewise a steel and concrete structure. In the case of this second crossing, the total length of the bridge is 1,137 feet, consisting of three steel truss spans with a combined length of 802 feet, seven reinforced concrete girder spans totaling 316 feet and two reinforced concrete cantilever spans with a length of 19 feet.

As in the case of the Robinson Ferry bridge the concrete deck of this structure is 26 feet between curbs and the sidewalks are each 4 feet wide.

$348,000 CONTRACT

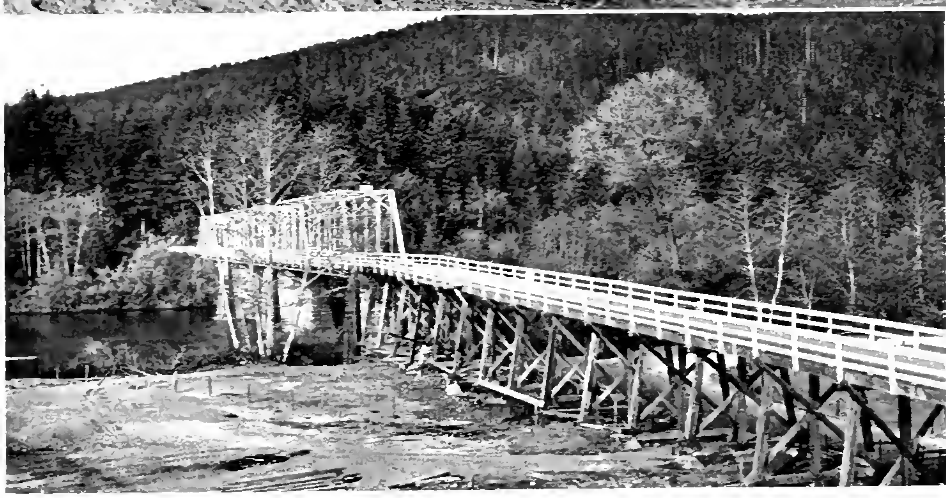
The same structural alloy steel was used in construction of this bridge as in the larger one at Robinson Ferry. The three truss spans of the north Scotia bridge required 1,950,000 pounds of structural steel and the concrete portions of the structure include 1,735 cubic yards of Portland cement concrete and 680,000 pounds of bar reinforcing steel. There are 137 piles as foundation support to the concrete piers and bents.

The contract for construction of the North Scotia bridge was awarded by Director Clark on February 20, 1940, to the firm of A. Soda and Son of Oakland. The cost of this bridge will amount to about $348,000 and the structure will be completed three months in advance of schedule.

Construction operations on the approaches to the two bridges have been under way on the new line since June 20th, when a contract was awarded for grading and surfacing the permanent approaches and connections with the existing highway. There is included in the proposed budget, adopted by the Highway Commission on December 31st last and now pending before the State Legislature, a project providing $106,500 for grading and paving the 1.4 miles between the two bridges.

U. S. Highway 101 follows the

New North Scotia Bridge which supplants old span on the left that has been condemned as unsafe by Division of Highways



Contrasting views of new and old Smith River bridges exemplifying highway improvement in Del Norte County

Pacific shore line from Vancouver to the Mexican border and one of the most picturesque sections is that which lies along the rugged coast of Del Norte County.

Traffic over this route shows steady increases year by year and in keeping with the purpose of the California Highway Commission and the Division of Highways to steadily improve the portions located in Del Norte County, on January 11, 1940, Public Works Director Clark awarded to contractor Joseph Shaw a State highway contract for the construction of a steel and concrete girder bridge, together with the necessary approaches, across the Smith River, 9½ miles north of Crescent City.

ON REVISED ALIGNMENT

This new structure, placed on a revised alignment down stream from the old and narrow steel truss and timber trestle bridge, is a marked improvement to this section of U. S. 101.

The new structure is 1,050 feet in length and consists of four steel girder spans aggregating 660 feet, two cantilever steel girder spans with a total length of 90 feet, 12 reinforced concrete slab spans totaling 280 feet and four cantilever reinforced concrete slab spans.

The girders rest on reinforced concrete piers and bents on pile foundations and spread footings. The width of the concrete deck of the new bridge is 26 feet between curbs, which is a most decided improvement over the 16-foot width of the old bridge.

The construction of the bridge required 1,065,000 pounds of structural steel, and the 2,500 cubic yards of Portland cement concrete required 625,800 pounds of reinforcing bars.

Approaches to the new structure are three-tenths of a mile in length and the construction of the 30-foot roadbed necessitated the movement of 62,500 cubic yards of earth.

Some one told us that a C. E. ruined the mechanical calculator in the Drafting Room. He divided a number by zero and burned out the bearings.

First Maid: "How did you like working for that college professor?"

Second Maid: "Aw, it was a rotten job. He was all the time quarreling with his wife, and they kept me busy running between the keyhole and the dictionary."

Modern 4-Lane Divided Highway Evolved from Old 18-Foot Pavement

By A. EVERETT SMITH, Assistant Highway Engineer

IN West Riverside the existing crowded two-lane road has been transformed into a beautiful four-lane highway with a central dividing strip to separate opposing lanes of traffic. In modern standards, it is surpassed only by limited access highways or freeways.

This project is a portion of U. S. Highway 60 that extends westerly three miles from the bridge across the Santa Ana River at the west city limit of Riverside on Mission Boulevard. It is a part of the State Primary Highway System.

The present improvement has evolved from a portland cement concrete pavement constructed to a width of 18 feet in 1914. In 1925-26 this road was widened to 20 feet and topped with a wearing course of asphaltic concrete.

As the traffic on this road steadily increased, in 1935 shoulders were constructed and a road-mix surface treatment applied 6 feet in width on each side of the pavement.

The transformation just completed has consisted, in general, of utilizing the existing traveled way to provide dual lanes for east bound traffic, and constructing two additional lanes for west bound traffic.

Divided highway through West Riverside business district. New pavement on right

As the existing right of way was inadequate for carrying out this expansion plan, it was necessary to acquire additional right of way throughout the project. This involved setting back many dwelling houses and business establishments, especially through the West Riverside business district. Facilities of Public Utility Companies were also affected. Numerous irrigation and domestic water lines were encountered which had to be lowered, encased in concrete or otherwise rearranged.

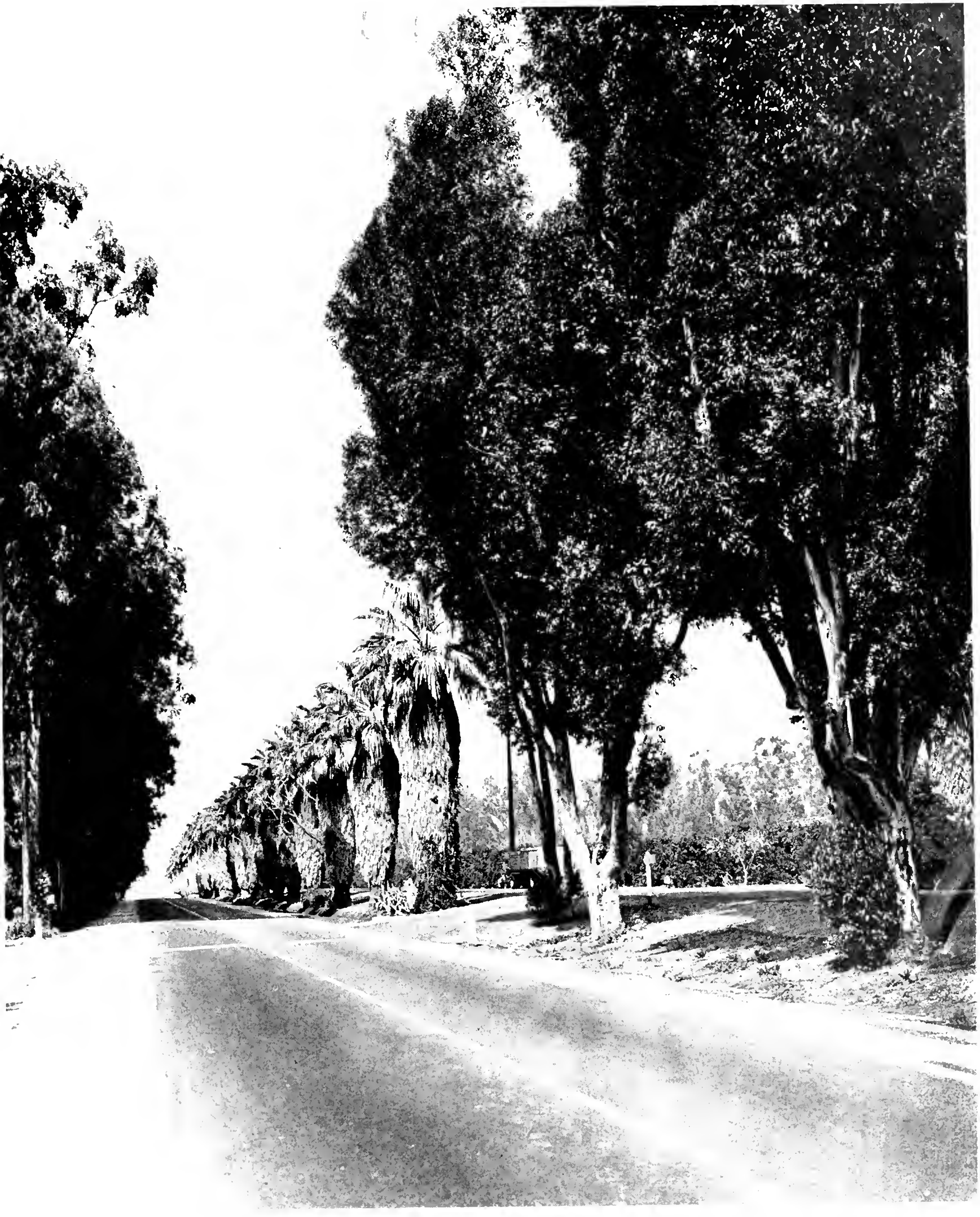
The new roadbed section consisted in general of constructing a subgrade of selected material 6 inches in thickness. Over this subgrade was placed a cement stabilized base 6 inches in thickness topped with 2½ inches of plant-mixed surfacing.

Material for the selected material subgrade and for cement stabilized base was obtained from roadway excavation near the west end of the job.

The specifications for the cement stabilized base, and the methods used in mixing and placing on the street

(Continued on page 15)


Flashing beacon marks dividing strip island which has cross-overs at intersections



Large Palms and Eucalyptus trees that bordered the existing 2-lane pavement on the left were conserved in the division strip of the new divided highway and make it one of the most beautiful sections of U. S. 60 in Southern California

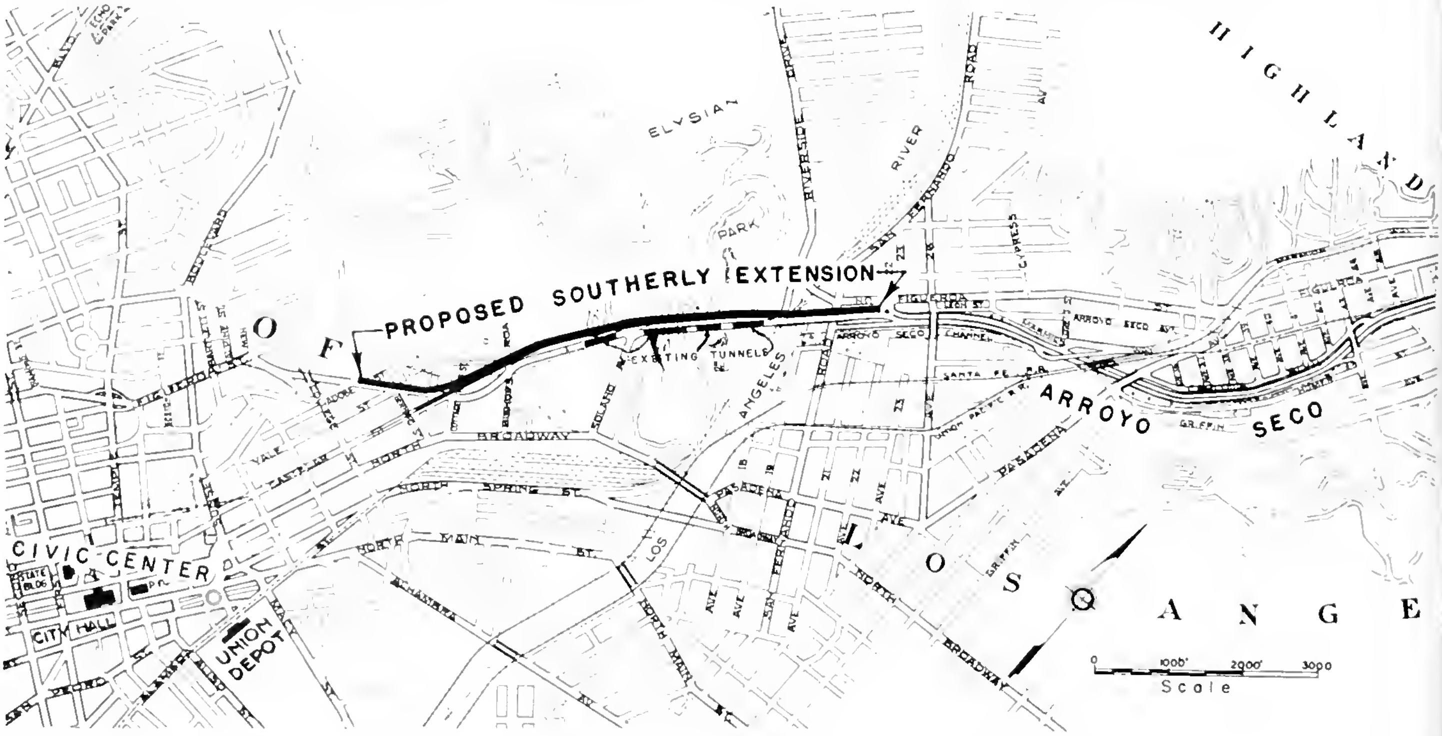
Extending Arroyo Seco Parkway Into Los Angeles Business Center

By JOHN G. MEYER, Assistant Office Engineer

FINANCED as a cooperative project by the Federal Government, the State of California and the City of Los Angeles, the work of extending the Arroyo Seco Freeway through Elysian Park southerly on Figueroa Street from Avenue 22 to Adobe Street in downtown Los Angeles is now under way.

The extension is necessary to relieve traffic congestion across the Los Angeles River Bridge, through the bridge over the Los Angeles River between Castelar Street and Avenue 22 for northbound traffic only; construction of a four-lane roadway for southbound traffic through open cuts in Elysian Park on the westerly side of the existing tunnels and at a higher elevation to facilitate grade separations for traffic at Solano Avenue, Bishops Road and at Castelar Street; construction of an additional four-lane bridge for southbound traffic, of the substructures of the Los Angeles River and Solano Avenue bridges.

Contracts have been advertised for the Castelar Bridge to cost about \$65,000. Bids for the Park Row Bridge to cost \$30,000 were opened on April 3d. Bids will shortly be taken for the Bishop Road and Amador Street bridges and for the Los Angeles River and Solano Avenue bridge superstructures.



Map showing proposed southerly extension of Arroyo Seco Parkway through Elysian Park into Los Angeles business district

Riverside Drive intersection and in the four Elysian Park tunnels which has greatly increased since the completion of the Arroyo Seco Freeway.

Approximately \$2,437,000 of WPA, Federal Aid, State Highway and City of Los Angeles funds will be expended on the improvement.

The general plan for the extension calls for the use of the four existing Figueroa Street tunnels through Elysian Park and the roadway and across the Los Angeles River upstream from the existing bridge, but at a higher level. The grade of the southerly end of this bridge will be above Riverside Drive to permit northbound Riverside Drive traffic to turn left under the new bridge.

The new work on Figueroa Street from Avenue 22 to Adobe Street will be on a freeway basis.

The WPA is engaged at present in grading operations and the building

The grading work involves the excavation of 550,000 cubic yards of earth and rock requiring 20,000,000 station yards of overhaul. A considerable portion or about 400,000 cubic yards of excavation is not required in the fills and is to be used in filling some of the Elysian Park Canyon areas which will assist in the beautification and development of that park.

(Continued on page 24)

iew of open cut under construction through Elysian Park in Los Angeles for southbound traffic extension of Arroyo Seco Freeway

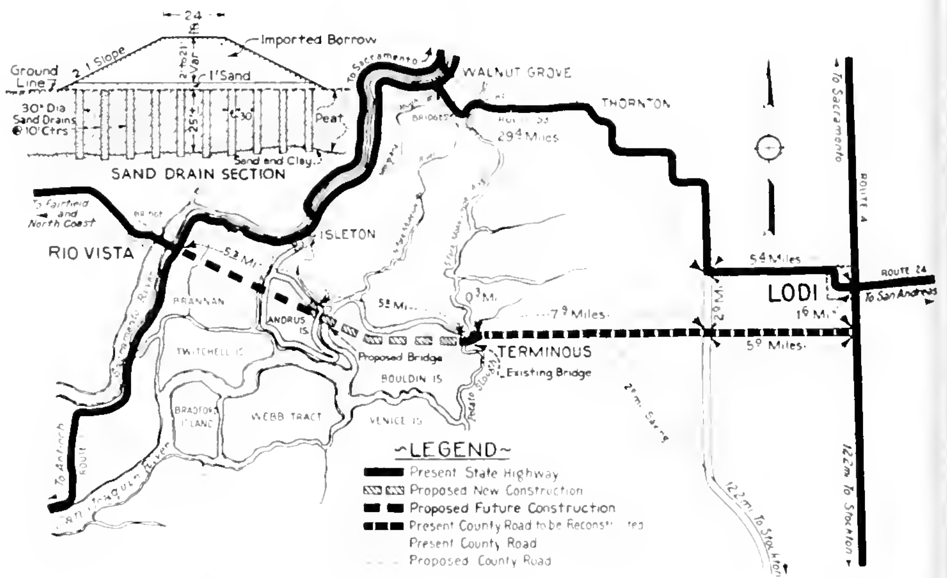
)pen cut construction parallels existing Figueroa Street tunnels for northbound traffic seen at left. Large fill will be built in foreground

Rio Vista to Lodi Short-Cut and New Bridge Now Under Way

By R. E. PIERCE, District Engineer

CONSTRUCTION of a portion of the new highway between Rio Vista and Lodi in San Joaquin and Sacramento counties, which will facilitate travel between the San Joaquin Valley and Rio Vista, is under way following official ground-breaking ceremonies held March 15th.

The work now under way consists of a bridge being built by contract over the Mokelumne River and a grading contract which will connect this new bridge with the bridge built several years previously across Potato Slough at Terminous, and a short section of highway west of the new bridge connecting with the county road leading to Isleton. From this intersection the present paved State highway from Isleton to Rio Vista will be used temporarily until funds are available to complete the direct route to Rio Vista.



Map showing location of proposed Lodi-Rio Vista short-cut and new Mokelumne River Bridge

The April, 1940, issue of CALIFORNIA HIGHWAYS AND PUBLIC WORKS carried an article on this road written prior to the completion of a test section on the west approach to the Potato Slough bridge, which included vertical sand drains placed under direct control of the highway laboratory personnel, and which was afterward covered by 40,000 cubic yards of fill material placed under contract.

The special provisions of the contract included strict control of placing the fill material, as was fully brought out in the article previously mentioned.

This fill has now been in place since the middle of last summer and has gone through a wet winter without showing any signs of displacing the natural material sideways as was the case in the fill built on the east approach to the Potato Slough bridge several years ago.

On the showing made by this experimental project the special provisions for the present grading contract includes an item for vertical sand drains under the approaches to the new bridge over the Mokelumne, and also provides that material in the roadbed may be placed in layers not to exceed 4 inches of sand where rolling or tamping is not required, and not over 1 foot in any 24-hour period. The right is also reserved to restrict the rate of placing material or to suspend operations or both; suspension not to exceed 10 days on any one portion.

The bridge contract now under way includes a bridge across the Mokelumne River and a ramp trestle on the west approach to the existing bridge at Potato Slough. The bridge across the Mokelumne River consists of one through steel truss swing bridge approximately 287 feet long with two adjacent steel stringer spans, each approximately 51 feet long, with fifty-five 19 foot timber approach spans, making a total length of 1434 feet.

The ramp trestle structure on the west approach to the Potato Slough bridge consists of five 19 foot timber spans with concrete deck. Both structures have a clear roadway width of 26 feet.

The grading contract includes as principal items 548,000 tons of imported borrow; 48,500 lineal feet excavating sand drains; 5,400 tons filling material for sand drains; and several minor items including roadway excavation, culverts, etc.

The contract allotment for the bridge is	$368,086.95
and for the grading	269,360.18
or a total of	$637,447.13

The bridge contractor is Tavares Construction Company, and the grading contractor is Clyde W. Wood, both of Los Angeles. A. N. Lund will be the Resident Engineer in charge of the road work, and C. C. Winters will be Resident Engineer for the bridge.

When completed to Rio Vista, this project as mentioned in the previous article, will eliminate a road with low standards of width, alignment and pavement, which runs for several miles along the narrow, crooked Sacramento River levee, crosses three substandard bridges, which are narrow and weak and with right angle turns on the approaches, and has other numerous right angle turns.

The distance from Rio Vista to U. S. 99 near Lodi will be shortened 11.1

(Continued on page 22)

$2,500,000 Storm Damage to Highways in February and March

By T. H. DENNIS, Maintenance Engineer

THE Division of Highways storm damage bill for February and March totaled two and one-half million dollars. Lacking adequate funds, the major part of this work of restoration must be postponed until the next biennial period. Obviously if our capital investment is to be preserved this work must have priority over other demands.

The damage though widespread was particularly severe in the Los Angeles area where rainfall records of the past 50 years were broken. Continuous soaking rains saturated the roadbed and slopes, causing the movement of large masses of rock and earth and either weakened or destroyed the pavement. California, with its extremes in climate and faulted geological formations coupled with its large registration of trucks and automobiles, truly presents a difficult and costly maintenance problem.

BIG EQUIPMENT JOB

During the past two months practically all of the Districts' efforts have been devoted to maintaining a passable roadway for traffic. This service in the Los Angeles district alone, required the use of 20 power shovels, and equal number of bulldozers and 80 trucks. With the end of the storm periods, restoration is now under way.

Restoration of shattered cut slopes, though costly, offers no great problem to power shovels and trucks. This is not true where the underlying support of embankments has been destroyed through saturation, wave or stream action, with consequent slippage. These involve extensive as well as expensive measures of correction and protection. The Eureka District's estimate for thirteen such corrections is $270,000.

In particular cases it may be necessary to remove thousands of cubic yards of material well below the original ground to again reach a stable foundation upon which to rebuild. In other instances, stability may be secured through the release of excess water in the foundation soil through hydrauger borings. Every location, however, will entail an individual study and plan of correction.

High Praise for Maintenance Crew

Santa Barbara, California

California Highway
Commission,
Sacramento, California.

Gentlemen:

I think it only fair that you know the appreciation of at least one of those who live in the mountains and depend upon the work of the maintenance crew located on the San Marcos Pass, Santa Barbara County.

First this crew was faced with a very serious forest fire. After the fire, came the resultant erosion caused by an all-time high rainfall record. During all of this trying winter the San Marcos maintenance crew has supplied to us who live in these mountains a service which must go beyond that imposed by regular line of duty. Time and again they have kept the road open when such a course did not seem possible.

If you have any sort of merit system, the men of the San Marcos Pass deserve to be on your honor roll. I have never met any of these men, excepting to wave as I pass them on the road. Rather than try to thank them, I thought the nicest thing might be to let their superiors, who are far away from the scene, know what splendid work they have done, and are doing, in maintaining the difficult San Marcos Pass road in Santa Barbara County.

Very truly,
Jack V. Wood.

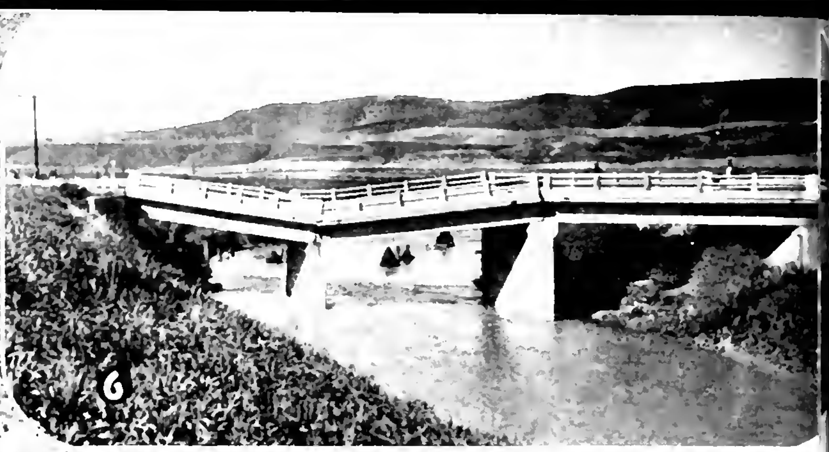
$100,000 DAMAGE BY WAVES

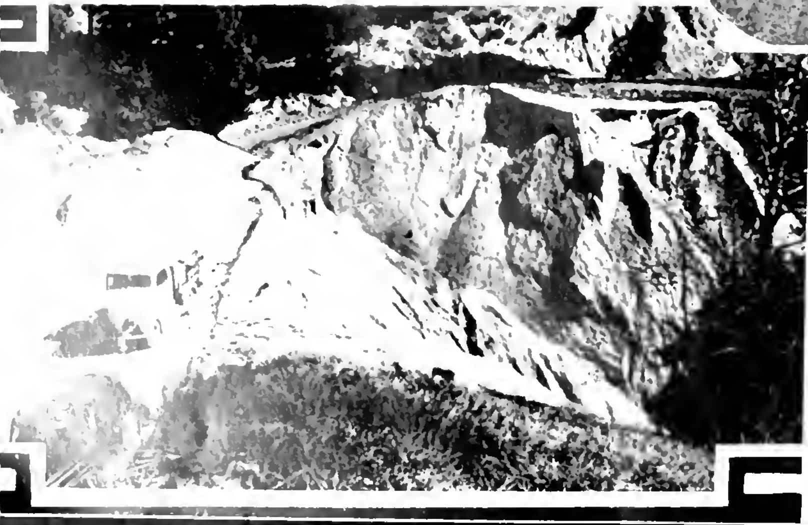
Protection against wave action is always expensive, and sometimes impractical. A situation of this kind exists on Route 56 between Edgemar and Thornton just south of San Francisco. Here one and one-half miles of roadway niched in a sandy formation midway between the ocean and the top of the bluffs is continually undermined by the pounding of waves. Maintaining this location can only be accomplished by moving back into the bluff after each onslaught of storm action; in effect, continuous rebuilding. Restoration at this location for the recent storm will exceed $100,000.

Protection of embankments against stream attack is likewise expensive and its type is dependent upon the stability of the foundation support. Many proven methods are available for this kind of work, including heavy rock riprap, sacked concrete, metal and concrete cribbing, concrete slope paving, sheet piling as well as pipe and wire netting. Studies are now under way at many locations where this type of damage occurred.

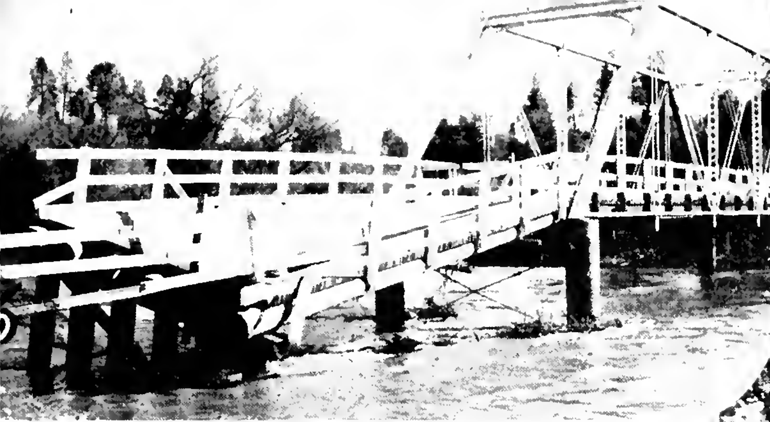
Since this article was prepared, continuing storms during the first week in April have increased the highway damage toll. Showers of cloudburst proportions temporarily closed Route 56, the Marin Coast Road; Route 116, the Santa Cruz-Boulder Creek Road; Route 21, the Feather River Highway, and the Weaverville lateral.

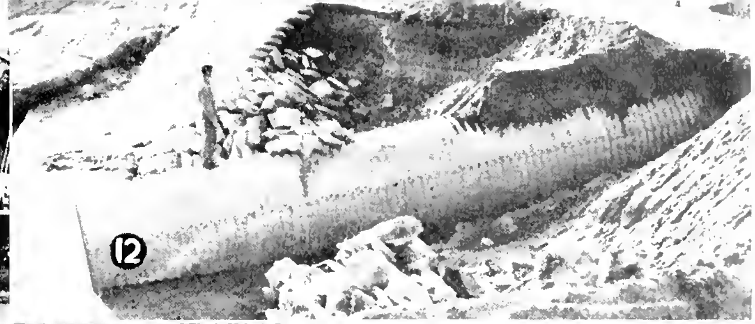
It will be seen from the foregoing and the accompaning views on the following pages, that storm damage repair will occupy highway forces for a number of months to come.

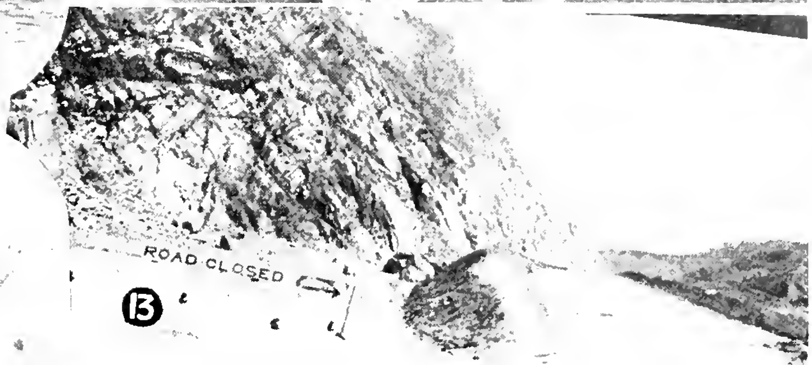




1. Slides of mud and rock covered section of Coast Highway 56 in Monterey County.
2. A slide of huge rocks closed U. S. 399, State Highway 138, in Ventura County north of Ojai.
3. Swollen waters of Cottonwood Wash tore out section of State Highway 194 in Riverside County.
4. Section of U. S. 99 washed out by flood water of Clear Creek in Shasta County.
5. Section of State Highway Route 20, Trinity lateral, washed out near Douglas City, Trinity County.
6. Cholame Creek bridge on State Highway 33 closed by undermining of pier by flood waters.
7. Slip-out on San Marcos Pass Highway along Santa Ynez River on State Highway 80, Santa Barbara County.
8. Wash-out on Tahoe-Ukiah Highway in Lake County caused by slide on opposite side of creek, forcing stream against bank.







Section of Cottonwood Creek bridge washed out on State Highway 29 in Tehama County.

Large slide on State Highway 50 in Colusa County, estimated 20,000 cubic yards.

Slip-out on State Highway 14 between Carquinez Bridge and Martinez.

Wash-out on Hesperia road in San Bernardino County.

Big slide closed State Highway 61 in Los Angeles County. Detour road on right.

Fill settlement on Downieville road, State Highway 25, in Nevada County.

Wash-out on Capistrano-Elsinore road, State Highway 64 in Orange County.

Wash-out on Topango Canyon road, State Highway 156, Los Angeles County, took out 2.47 miles of road.

Equipment grading for relocation of State Highway (U. S. 99) through mountains north of Shasta Dam at south end of the Antler bridge across the Sacramento River in Shasta County. Abutment of bridge is seen at right of picture.

Heavy Grading Jobs in Relocation Around Shasta Dam Reservoir Site

GRADING work on the realignment of the Pacific Highway around Shasta Dam reservoir site involving some of the heaviest excavation ever undertaken in northern California, has progressed to a point where its completion early this summer is assured.

Reconstruction of 15.5 miles of the Pacific Highway is an integral part of the Central Valley Project. The State's share of the cost of relocating the highway approximates 10 per cent of the grading and surfacing costs and 23.5 per cent of the cost of a bridge across the Sacramento River near Antler.

When the work adjacent to the south end of the Antler bridge is finished, the contractors, Granfield, Farrar & Carlin, will have completed one of the roughest grading jobs the Division of Highways ever has let to contract.

Of the 15.5 miles of realignment, 2.5 miles was constructed by the United States Bureau of Reclamation in conjunction with the relocation of the railway lines of the Southern Pacific. The highway bridge across the Sacramento River at Antler and the joint highway and railway bridge across Pit River together represent 0.9 of a mile. The balance of approximately 12 miles is covered by current grading contracts being performed by Granfield, Farrar & Carlin.

Contracts for realignment involve a unit of 4.8 miles between Bass Hill and O'Brien Summit, southerly section of the relocation that lies on either side of the Pit River bridge. This contract called for the movement of about 1,164,000 cubic yards of excavation.

Another contract which will complete the grading for the highway realignment involves 8.1 miles from O'Brien Summit to a point near Antler and will require the movement of 1,393,000 cubic yards of excavation. The approximate cost of these two units is $416,238 and $393,737, respectively.

The cut adjacent to the south end of the Antler bridge is something over 175 feet from the ground elevation to highway grade. However, it is not as outstanding as heavy work on the contract as some other cuts which are as high or higher. There are two cuts running up to 232 feet and 275 feet and three fills of 185 feet, 220 feet and 289 feet.

The fill represented by one of these cuts required a quarter of a million yards to bring it to grade. The deepest cuts are adjacent to the highest fills and in some cases it was necessary to move the material from the highest point into the lowest part of the fills over very steep terrain. This required some very extensive pioneer operations.

The entire realignment section will require the moving of approximately 2,850,000 cubic yards of material. The heaviest cut and fill work is embraced within a one-mile stretch of the reclamation and necessities 725,881 cubic yards of excavation. In other words, about one-quarter of the excavation on the entire 12 miles occurs in this area alone.

When the grading contracts are completed this summer, contracts for surfacing will be let. The entire relocation will not be open for traffic until completion of the Pit River bridge, now being erected by the American Bridge Company under contract with the Bureau of Reclamation.

The surfacing of the new highway will consist of crusher run base and plant-mixed bituminous treated top, except through the Southern Pacific subway near Antler, where Portland cement concrete will be used. The estimated cost of this surfacing is $335,000.

Modern 4-Lane Divided Highway

(Continued from page 6)

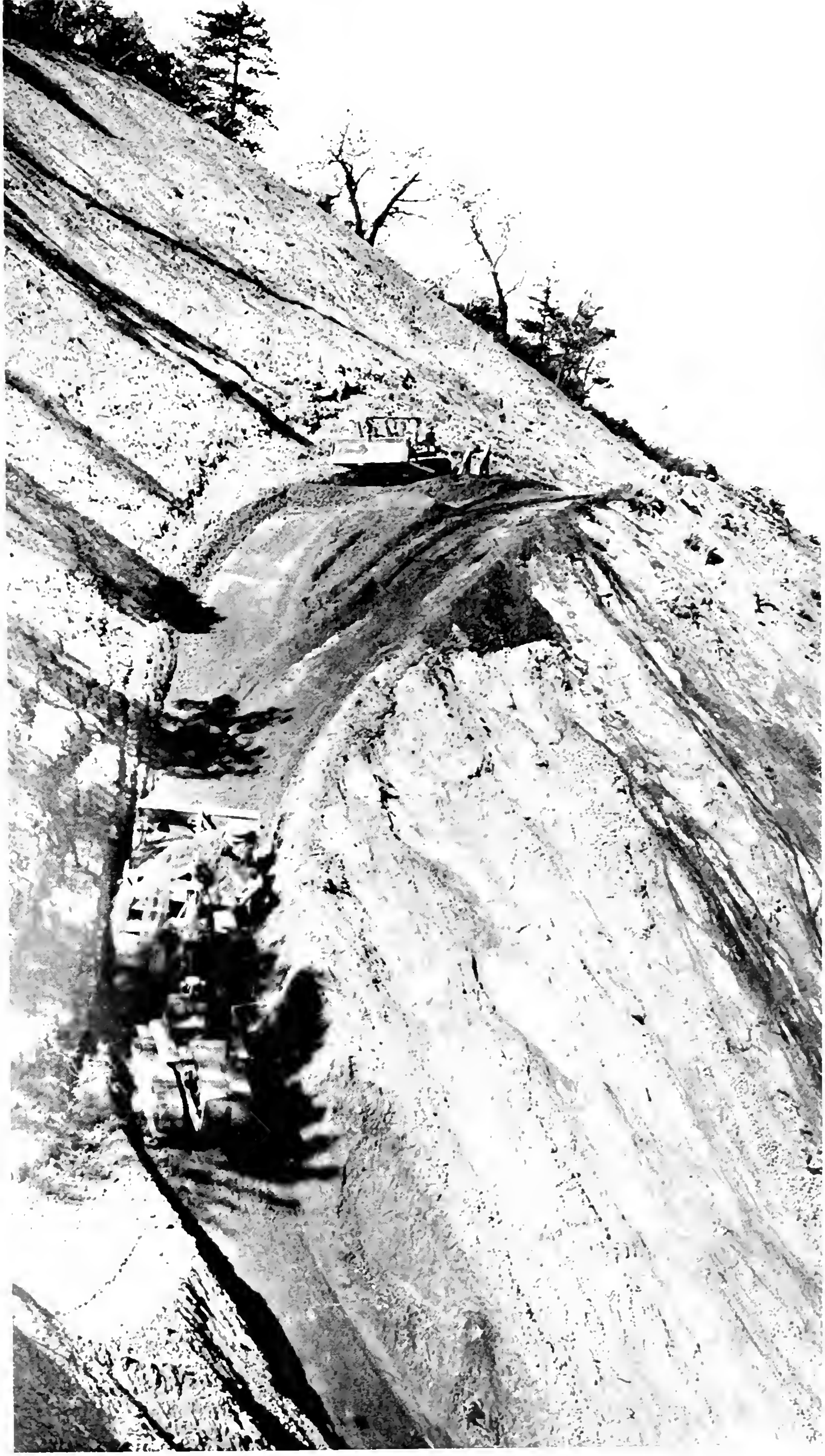
are quite similar to those described in an article in the March, 1941 issue of this journal on the Beaumont-Banning four-lane highway construction. However, due to the excellence of the material available on this project, the water control was less critical and the operations of spreading and consolidating on the street presented fewer difficulties.

Through the commercial area of West Riverside standard curbs were placed near the property line. The central dividing strip was also curbed with a roll type curb and gutter placed monolithically. Through the balance of the project the new construction was at a different grade elevation from the existing pavement and the dividing strip was not curbed. Cross-overs were provided at all street intersections.

At each end of the project, at the termini of the dividing strip islands, flasher beacons were installed. These are to aid approaching drivers to observe the presence of the island.

The old existing roadway was for the most part bordered by large eucalyptus, pepper and palm trees. The location of the new improve-

(Continued on page 22)



Grading down steep mountainside for Antler Bridge approach

Factors Governing Selection Of Asphaltic Surface Types

By THOMAS E. STANTON*, Materials and Research Engineer

* A discussion of a portion of the paper on "Factors Governing the Selection of Asphalt Surface Types" presented by Professor Lloyd F. Rader of the University of Wisconsin at the recent National Asphalt Conference.

A NUMBER of factors must be recognized as having an influence on the choice of asphalt surface types. One of the most important of these factors is the personal equation or prejudice of the individual engineer for or against some particular design of bituminous surfacing, depending on his experience with the local materials and conditions under which he may be working.

In addition to the personal equation the more tangible factors influencing a selection are: climatic conditions; differences in soil and drainage; nature and condition of subgrade and base; variations in amount and weight of traffic; and (very important) limitation in funds.

The new California Standard Specifications adopted November 15, 1940, recognize the following types of bituminous surfacing:

1. **Penetration Oil Treatments**
2. **Seal Coats**
3. **Bituminous Surface Treatment**
4. **Armor Coat**
5. **Retread Surfacing**
6. **Non-Skid Surface Treatment**
7. **Road Mix Surfacing**
8. **Plant Mix Surfacing**
9. **Bituminous Macadam Surfacing**
10. **Asphaltic Concrete**

A brief description of the use of each type is as follows:

1. PENETRATION TREATMENT

This type of construction is similar to the so-called dust oiling (done as a temporary expedient to maintain the existing surface in a dustless condition) but it is often applied to imported borrow or selected materials on shoulders in new construction.

2. SEAL COATS

Seal coat construction as practiced in California consists of the application of a bituminous coating or coatings of any one of a number of grades and then covering with imported screenings uniformly graded from coarse to fine. This type of construction is used principally to restore or protect old surfaces which have a tendency to ravel or which need protection from surface water. Also used to reduce skid hazard. Type B heavy seal is used as a wearing surface over untreated bases where light traffic does not warrant a heavier surfacing.

3. BITUMINOUS SURFACE TREATMENT

This is a road mix treatment of the existing material in the roadway or with cheap imported select material it is used when the local material is suitable for mixing with oil and there are insufficient funds to cover the cost of a more expensive treatment.

4. ARMOR COAT

The armor coat type is usually constructed using liquid asphalts of the SC-6 grade or the penetration type asphaltic emulsions and is constructed to a greater thickness than the ordinary seal coat; three applications of the bituminous binder and screenings in addition to a seal coat being used. The crushed screenings in this case are in commercial sizes graded from coarse to fine, the maximum size being approximately ¾ inch. This type of construction is used where there is an excellent base which justifies the construction of a relatively expensive type of bituminous surfacing but does not justify the expense of adding additional imported material to a thickness of several inches of either the road mix or plant mix type. Frequently used on wooden bridge decks to accommodate flexure.

5. RETREAD SURFACING

This type of surfacing consists of bituminous binder and aggregate mixed, spread and compacted over the surface of an existing pavement which requires a light re-surfacing. It usually consists of two applications of rock and bitumen spread and mixed on the existing pavement followed by a seal coat. In effect, a mixed-in-place armor—advocated for leveling up old rough pavements which are otherwise structurally adequate.

6. NON-SKID SURFACE TREATMENT

This type of treatment consists of a single application of bituminous binder and special close graded screenings to the surface of an existing pavement which has become slippery from use. In this type of construction the bituminous binder is usually of the penetration type asphaltic emulsion. Quantity of binder is limited and screenings are of hard stone (5 to 20 L.A. rattler wear).

7. ROAD MIX SURFACING

This type of construction consists in importing select graded aggregate and mixing on the road with various grades of bituminous products to a depth of several inches and is used where an appreciable thickness is required and funds are available for the purpose. The road mix type of surfacing is specified or permitted in California where the job is of insufficient size to justify setting up and mixing the material in a central mixing plant. Many contractors have elected to substitute plant mix construction even when road mixing is permitted.

8. PLANT MIXED SURFACING

This is the preferred type of low cost road construction in California and is of general use wherever the volume of traffic, funds available, etc., do not justify the construction of the more expensive asphaltic concrete type. The material is usually dried to low moisture content and mixed with bitumen at a central mixing plant and spread and compacted on the prepared base usually to a thickness of 2″ to 3″, although under special conditions the thickness may not exceed 1½″. Four inches is the maximum thickness approved for this type of construction.

9. BITUMINOUS MACADAM SURFACE

This type of construction is not extensively used in California primarily because of the difficulty of securing as smooth and dependable construction as with the plant mixed types. Few engineers today have had sufficient experience with this type of construction to guarantee satisfactory results. There are certain occasions, however, where the local commercially produced crushed aggregate particularly lends itself to the penetration macadam type of construction and contractors are available who thoroughly understand this method. Under these and some other conditions the bituminous macadam type has its place in the picture.

10. ASPHALTIC CONCRETE

The asphaltic concrete type is usually preferred wherever it is anticipated that the traffic will exceed 5,000 to 10,000 vehicles per day and it is at the same time necessary to use a pavement construction exceeding 3″ in thickness or thicknesses less than 3″ on a previously constructed high type pavement base.

It will be noted that there is no provision for the Sheet Asphalt Type in California specifications. This type has been omitted in favor of the dense graded coarser aggregate types which are considered as:

(a) Less expensive. (b) Normally more stable in the thicknesses constructed. (c) Less likely to become slippery through the flushing of excess bitumen to the surface or oil drippings from motor vehicles.

Highway Magazine Is Read In South Africa

UNION OF SOUTH AFRICA

Department of Agriculture and Forestry
Burlington House

Pretoria
February 21, 1941

Department of Public Works,
Sacramento, California.

Gentlemen:

I beg to acknowledge receipt of the publications forwarded under cover of your letter of December 30th, last, for which I thank you.

It would be appreciated if you could place the name of this Division on your mailing list to receive all issues of your Department magazine in the future.

Signed,
HANS FAUELDE,
Director of Forestry.

Through experience our ideas on the selection of pavement types have undergone a steady change. Economic pressure, that is demand for increased mileage accompanied by reduction in funds available per mile of road have tended to greatly stimulate the construction of low cost surfacing. The problem lies in keeping construction costs down without causing a disproportionate increase in maintenance costs. Naturally, the construction engineer is more likely to be attracted by a low initial cost while the maintenance engineer is more vitally interested in durability and low upkeep.

A survey of the California rural state highway system as of December 31, 1938, indicated a total mileage of bituminous surfacing distributed under the various types as follows:

Asphaltic concrete	1,304
Bituminous macadam	999
Plant mix gravel	1,343
Road mix gravel	1,887
Oiled gravel	1,594
Oiled earth	2,644

The preceding tabulation does not delineate the mileage of armor coat or "two shot" seal coat construction. This mileage is included in the oiled gravel section. Eliminating the mileage of oiled earth, which is largely in the form of dust oiling of existing country road surfaces, 63% of the bituminous surfaced mileage of California highways consists of a dense graded mixture of the road mix, plant mix, or asphaltic concrete type.

In selecting types of bituminous surfacing, the volume of traffic is most commonly cited in justifying some particular design of surface. Ten years ago it was almost universally agreed that the oil mix type of road, whether plant or road mix, was suitable only for roads carrying light traffic and its use was commonly justified on the grounds of stage construction; that is, to serve temporarily until funds were available for a so-called standard high type pavement.

At the present time, however, we are constructing plant mix surfacing using slow or medium curing liquid bituminous products as a binder on roads carrying materially in excess of 5,000 cars per day. The position of the various types of bituminous surfacing is not static so far as selection for certain traffic conditions is concerned and the trend is definitely toward a more extensive use of the low cost type to more heavily traveled roads.

A considerable mileage of concrete and asphaltic concrete pavement has been resurfaced with so-called armor coat. This is a type of construction found in most states but designated by various titles. It consists of two or more layers of clean stone held in place by successive applications of liquid asphalt. The size of stone, the number of applications, and the grade of asphalt binder used may vary considerably but the general principle is the same. This sort of construction has been quite satisfactory over good foundations and in areas where snow removal is not necessary. However, the armor type has not been consistently satisfactory in the presence of any base defects or in the high mountain regions where many failures have been caused by snow removal equipment or by destruction due to freezing and thawing.

The most generally satisfactory type has been the dense graded plant mix surface from two to three inches thick and preferably three inches.

(Continued on page 22)

Snow Survey Report Forecasts The Sierra

Very High Water Stages Are Expected in the San Joaquin

AN ABUNDANT summer water supply for all of California is predicted in the annual forecast of stream run-off made by the Division of Water Resources on the basis of data collected through the California Cooperative Snow Surveys.

The preliminary estimate of run-off issued April 10th by the division shows that for streams in the Sierra as a whole the flow will be 20 per cent above normal.

Although only slightly above average in the north and relatively lighter in the American River region, the snow surveys show that the snow pack increases rapidly to the south and is very heavy in all watersheds to the east of the San Joaquin Valley where it averages around 30 per cent above normal.

LIMITED STORAGE AREAS

In the San Joaquin River and all of its eastern tributaries the report predicts very high water stages can be expected during the usual hot spells of late May and early June. High water stages during the period of maximum run-off will be only nominal in the Sacramento River and its tributaries.

On the Kings, Kaweah, Tule, and Kern rivers the unregulated peak flows from melting snows will exceed the irrigation demands of districts supplied from these streams, and the surplus water will find its way into the Tulare Lake bottoms. The limited storage still remaining in the present flooded areas of Tulare Lake is inadequate to accommodate the surplus of run-off indicated by the snow surveys and the report says, "it appears that the inundation of additional areas is inevitable."

The forecast of watershed run-off for Sierra streams during the four months melting period, April 1st to July 31st, ranges from a low of 83 per cent of normal for the American

SIERRA WATERSHED

The watershed tributary to Shasta Dam, which will supply the water for Shasta Reservoir, is shown in the above illustration. In this watershed the State conducts cooperative snow surveys on twelve snow courses and six precipitation stations. On data compiled from snow surveys and precipitation record, the State estimates the anticipated stream run-off for the summer season. These estimates will prove highly valuable in the operation of Shasta Reservoir.

The snow courses are: A, Mt. Eddy; B, Grey Lock Lakes; C, Mt. Shasta; D, Buck Mountain; E, Snow Mountain; F, Big Springs; G, Logan Lake; H, McElroy Pass; I, Adin Mountain; J, Eagle Peak; K, Cedar Pass and L. Blue Lake. Precipitation stations are: 1. Alturas; 2. Fall River Mills; 3. Hat Creek Power House; 4. McCloud; 5. Mt. Shasta City and 6. Kennett (not shown in the illustration).

to a high of 180 per cent for the Kern River.

HIGH RUN-OFF STREAMS

The estimated per cent of normal run-off by streams is as follows: Sacramento River at Kennett, 124 per cent; Feather River near Oroville, 92 per cent; American River at Fair Oaks, 83 per cent; Mokelumne River near Mokelumne Hill, 101 per cent; Stanislaus River below Melones Power House, 107 per cent; Tuolumne River at La Grange, 132 per cent; Merced River at Exchequer, 139 per cent; San Joaquin River at Friant, 130 per cent; Kings River above Piedra, 132 per cent; Kaweah near Three Rivers, 134 per cent; Kern River near Bakersfield, 180 per cent.

The past season's heavy precipitations, the report shows, has had very uneven distribution throughout the State. All stations west of the Sierra

-off Will Be 20 Per Cent Above Normal

Precipitation South of the Tehachapi is 65% Above Normal

rest report precipitation to date ranging from 10 per cent to 50 per cent greater than normal. South of the Tehachapi the excess precipitation is greater than in the north ranging from 40 per cent to 95 per cent above normal.

SNOW PACK PERCENTAGES

The actual snow pack distribution in per cent of normal for the Sierra as shown by the snow surveys is as follows:

Upper Sacramento, McCloud and Pit rivers, 105 per cent; Feather River, 108 per cent; Truckee, 74 per cent; Tahoe, 75 per cent; American, 77 per cent; Mokelumne, 104 per cent; Stanislaus, 112 per cent; Tuolumne, 113 per cent; Merced, 125 per cent; Upper San Joaquin, 124 per cent; Kings, 128 per cent; Kaweah, 125 per cent; Kern, 171 per cent.

The snow survey made in the watersheds of the Upper Sacramento, McCloud and Pit rivers—the tributary drainage area to Shasta reservoir—show that the high mountains of the Trinity Divide and also of Mt. Shasta to the east have a snow pack range from 7 to 19 feet in depth with an equivalent content of from 39 inches to 109 inches of water.

Snow depths over the high areas of the far-reaching Pit River watershed are not so heavy, but this winter's rains have, to a great extent, filtered into the lava beds in this section and will continue to supply the stream channels all next summer.

With regard to Shasta reservoir, the following assumptions may be made:

Records compiled by the United States Geological Survey of the monthly flow of the Sacramento River at Kennett show that had Shasta Dam been completed last October the run-off up to March 1 would have more than filled the reservoir to its flood control capacity. Shasta reservoir is designed to store 4,500,000 acre-feet of water. Of that capacity 500,000 acre-feet is reserved for flood control.

SHASTA RESERVOIR CAPACITY

Run-off figures compiled by the United States Geological Survey show that from October until March 4th, 4,457,100 acre-feet of water flowed past Shasta Dam site at Kennett. Between March 4th and April 1st, the Division of Water Resources has estimated from gauge height records that the run-off was an additional 780,000 acre-feet.

The snow survey bulletin, however, estimates that the run-off between April 1st and October 1st will amount to 2,500,000 acre-feet. Thus, with the water which has flowed past Shasta Dam site since October 1st, Shasta reservoir could have been filled to capacity more than one and one-half times during the present rainy season.

FUNDS INCREASED

President Roosevelt, on April 2d, submitted to House Appropriation Committee, a recommendation that Central Valley Project appropriation for this year be increased from $25,000,000 to $38,750,000.

The Budget Bureau statement submitted in connection with the recommendation stated the additional funds were needed to enable the Reclamation Bureau to accelerate during 1942 the construction of the project and to speed the availability of power and provide additional power facilities to meet an anticipated power shortage in the northern and central parts of the State.

The additional funds contemplate installation of a steam generating plant near Antioch of 150,000 K.W. capacity, additional transmission facilities and the start of construction on an afterbay dam and power plant at Keswick, together with the start of work on the Friant-Kern canal.

Final Work on Mountain Springs Grade Highway Is Under Way

THE award on March 13, 1941, of the contract for grading, surfacing and bridge construction, to the Denni Investment Corporation, marks the final step toward the completion to modern standards of the famous Mountain Springs Grade.

The latest contract is the third unit of construction to be let in traversing the 7.18 miles of the most rough and difficult mountain range between the Imperial Valley and San Diego. The first unit of construction covered a distance of 2.55 miles, starting at the top of the grade near Boulder Park. This first unit was let to the A. S. Vinnell Company and was accepted by Director of Public Works Frank W. Clark on August 28, 1939.

The second unit was awarded to the Denni Investment Corporation on July 11, 1940, construction of which is now under way and is scheduled for completion in July of this year. This unit is for a distance of 3.64 miles and begins near the old Mountain Springs Station, and extends easterly down the In-ko-pah Gorge.

The last unit most recently awarded, extends easterly from the second, a distance of 1.29 miles to a point near Millers and the foot of the grade.

The old alignment contained 79 curves having a combined curvature of 3,668 degrees. The minimum radius was 126 feet and there were 42 curves having radii of 300 feet or less. The new alignment has only 33 curves with a minimum radius of 600 feet and a combined curvature of only 1,555 degrees. In addition, the maximum grade has been reduced in excess of 1.1 per cent.

Because of the improved sight distance, due to decrease in curvature, and the change in grade, passenger cars are now able to travel the completed section at the top legal rate of speed, in place of the old slow safe speed of approximately 20 miles per hour.

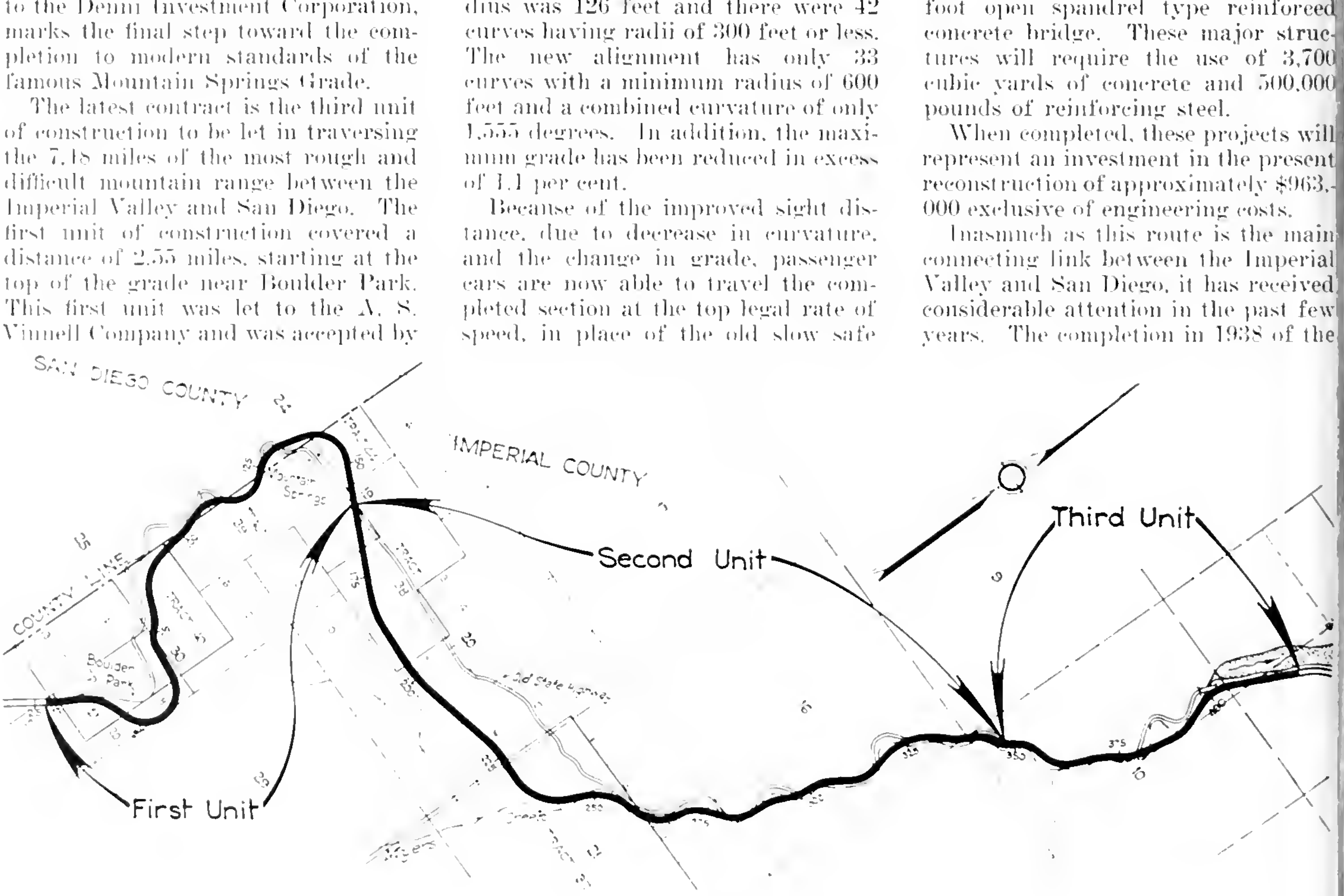
The three contracts when completed will involve the movement of nearly 800,000 cubic yards of rock roadway and channel excavation requiring approximately 500 tons of dynamite. In compacting the embankments and flushing the fines down through the voids in the rocky embankments, approximately 42 million gallons of water will be used.

Thirty-five thousand cubic yards of imported borrow and 1,500 tons of liquid asphalt will be used in the road-mix surface treatment, and in providing for crossings over the main stream bed it will be necessary to construct eight large arch culverts and one 120-foot open spandrel type reinforced concrete bridge. These major structures will require the use of 3,700 cubic yards of concrete and 500,000 pounds of reinforcing steel.

When completed, these projects will represent an investment in the present reconstruction of approximately $963,000 exclusive of engineering costs.

Inasmuch as this route is the main connecting link between the Imperial Valley and San Diego, it has received considerable attention in the past few years. The completion in 1938 of the All-American Canal in the Imperial Valley has doubled the possible irrigable agricultural lands and in so doing has vastly increased the potential traffic over this road.

Modern engineering and construction accomplishments have done much to surmount the Mountain Springs barrier which has ever been an obstacle in railway and highway transportation plans.



Sketch map showing progress of improvement on Mountain Springs Grade Highway

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Football Coach (to players): "And remember that football develops individuality, initiative and leadership. Now get in there and do exactly as I tell you."

Highway operations on Mountain Springs grade in San Diego County. 1—Grading completed through cut. 2—Concrete arch culvert 21 feet wide. (Note figure of man.) 3—View of existing road showing extreme curvature. 4-5—Heavy grading and drilling scenes

Governing Selection of Surface Types

(Continued from page 17)

If properly designed and constructed, this type of surface is economical to place and lends itself readily to a variety of construction operations. In skillful hands the finished riding qualities and surface textures are second to no other type.

To summarize briefly the factors which influence the selection of the type of bituminous surfacing, the following items are most frequently given consideration:

1. Thickness of blanket course; 2. Type and quality of subgrade; 3. Availability of satisfactory aggregates; 4. Type of construction, whether new pavement or resurfacing; 5. Volume of traffic; 6. Type of traffic, percentage of trucks, etc.; 7. Type of adjacent pavement; 8. Economic considerations.

The present practice in California is to predicate design standards for alignment and pavement type on the estimated traffic for the year 1965. This estimate is commonly arrived at by doubling the 1938 count except where special local conditions indicate an unusually high or abnormally low expected increase.

NO FIXED RULES

There are no fixed standards or rules which establish mandatory requirements in choosing a definite type of surface for a given volume of traffic. Plant mix surface of a type which has proved satisfactory for traffic up to 5,000 cars per day in the arid regions of the state, has been constructed for $3,000 per mile while $10,000 a mile may be necessary to carry the same volume of traffic in the regions of heavy rainfall and poorer subgrade conditions.

Each problem is treated as a special case. While on the face of it selections may appear inconsistent, it is felt that this procedure is more intelligent and economical than trying to fit conditions to arbitrary rules.

It can be stated that in general:

Road mix surface treatment of local materials may be used for traffic up to 3,000 cars per day.

Road mix surfacing with imported graded aggregate may be used for 1,000 to 5,000 cars.

Plant mix surfacing may be used for traffic of from 1,000 to 12,000 cars.

Asphaltic concrete is commonly used on roads carrying more than 8,000 cars per day.

While the general trend is to use the heavier types of construction for roads carrying the greatest volume of traffic, there is nevertheless much overlapping; indicating that traffic alone is not the sole determining factor. The actual type selected results from a summation of all elements which can be evaluated.

Motor travel from coast to coast in Canada will soon be possible with completion late this year of the last link of an east-west highway. The final gap being closed is between Hearst and Geraldton in the northwest part of Ontario. It is being built through entirely virgin territory at a cost of about $6,000,000, it is stated.

Captain—Why didn't you shave this morning?

Private—I thought I did, sir, but there were twelve of us using the same mirror this morning and I must have shaved some other guy.

March Traffic on State Toll Bridges Shows Big Increase

During the month of March the traffic volume on the three State-owned toll bridges reached a high level, especially on week ends. The figures for March, 1941, exceed the records for the same month of 1940 by a wide margin. The daily average for the San Francisco-Oakland Bay Bridge for the month was 48,248 and the highest single day's traffic was 60,116, occurring on Sunday, March twenty-third.

On the Carquinez Bridge a new high schedule was established with an average of 10,055 vehicles per day.

The traffic over the Antioch Bridge showed an increase of more than one-third over the record of March, 1940.

The total traffic for March on the San Francisco-Oakland Bay Bridge and the Carquinez and Antioch Bridges is tabulated below:

	San Francisco-Oakland Bay Bridge	Carquinez Bridge	Antioch Bridge
Passenger autos and auto trailers	1,366,410	283,661	14,106
Motorcycles and Tricars	3,367	658	28
Buses	26,530	4,755	190
Trucks and truck trailers	73,497	22,405	2,727
Others	25,899	223	23
Total Vehicles	1,495,703	311,702	17,074

Rio Vista to Lodi Short-Cut and New Bridge Now Under Way

(Continued from page 10)

miles, and the distance from Stockton will be shortened 12.7 miles. A proposed change in the county road leading from Stockton will cut off another 2.0 miles making a total saving of 14.7 miles from Stockton to Rio Vista.

This road will be the most direct route from the Lodi-Stockton and south San Joaquin Valley to the area north of San Francisco Bay and to the Redwood Highway. It will also tap the rich delta agricultural area in this vicinity which at present has no direct road connection.

Modern 4-Lane Divided Highway

(Continued from page 15)

ment was so established that the northerly row of trees came within the confines of the dividing strip. In addition to their natural beauty, these trees add materially to decreasing headlight glare.

Landscaping was provided by placing top soil in the curbed areas and putting in a heavy planting of rose cuttings.

The work was performed by Matich Bros., Contractor. Mr. E. A. Bannister was the Resident Engineer.

Highway Bids and Awards for the Month of March, 1941

CALAVERAS, STANISLAUS, TUOLUMNE AND AMADOR COUNTIES—urnishing and applying diesel oil to about 54 miles of roadside vegetation. District . Various routes. Rotary Oil & Burner o., Sacramento, $3,432. Contract awarded Sheldon Oil Co., Suisun, $2,700.

FRESNO COUNTY—Between Selma and owler, about 4.7 miles to be graded, asphalt oncrete pavement to be constructed and a ridge to be widened. District VI, Route 4, ection A. Fow. Union Paving Co., San rancisco, $170,670; Griffith Co., Los Angees, $175,987. Contract awarded to Piazza Huntley, San Jose, $153,430.

IMPERIAL COUNTY—Between Mounin Springs and Millers, about 1.3 miles to e graded and bituminous surface treatment pplied and a reinforced concrete bridge to e constructed. District XI, Route 12, Secon A. Clyde W. Wood, Los Angeles, 299,677; Maeco Construction, Clearwater, 325,195; Heafey-Moore Co., Fredrickson & Watson Construction Co., Oakland, $366,-13; A. S. Vinnell Co., Alhambra, $406,921; alph A. Bell, San Marino, $415,810. Conract awarded to Denni Investment Corp., Wilmington, $294,193.

LOS ANGELES COUNTY—On Artesia venue, one mile east of Bellflower, a reinorced concrete bridge across San Gabriel iver to be constructed and approaches bout 0.4 mile long to be graded and surced with plantmixed surfacing. District II, Route 175, Section B. Carlo Bongiovanni, Hollywood, $79,454; Martin & chmidt, Contractors, Long Beach, $79,708; . S. Metzger & Son, Los Angeles, $87,588; ontracting Engineers Co., Los Angeles, 89,957; Mittry Bros. Construction Co., Los ngeles, $94,504; J. E. Haddock, Ltd., asadena, $98,654. Contract awarded to Verner & Webb, Los Angeles, $71,812.

LOS ANGELES-ORANGE COUNTIES—At East Fork of Coyote Creek, 1.3 miles est of Buena Park, a reinforced concrete ab bridge to be constructed and about 0.3 ile of approach roadway to be graded and urfaced with plantmixed surfacing. District VII, Route 175, Section C. E. G. erham, Los Angeles, $18,879; Martin & chmidt, Long Beach, $18,882; Griffith Co., os Angeles, $20,285; Roland T. Reynolds, naheim, $20,589; J. S. Metzger & Son, os Angeles, $21,798; Contracting Engineers o., Los Angeles, $22,966; J. E. Haddock, td., Pasadena, $23,424; Carlo Bongiovanni, Hollywood, $25,777. Contract awarded to Verner & Webb, Los Angeles, $16,831.

LOS ANGELES COUNTY—0.5 mile of rading and paving with asphalt concrete avement on Foothill Blvd. between Las omas Avenue and Irwindale Avenue. District VII, Route 9, Section G. Oswald ros., Los Angeles, $15,775; Griffith Co., os Angeles, $16,936. Contract awarded to . E. Haddock, Ltd., Pasadena, $15,021.

MENDOCINO COUNTY—At Ferguson ulch and McNamee Creek, about 0.9 mile o be graded, seal coat to be applied, and wo reinforced concrete arch culverts to be onstructed. District I, Route 56, Section . J. L. Conner & Sons, Calistoga, 59,949; Lee J. Immel, Berkeley, $65,621; ouis Biasotti & Son, Stockton, $68,976; Kiss Crane Service, Berkeley, $69,600; Poulos & McEwen, Sacramento, $69,610. Contract awarded to Claude C. Wood & L. . Tonn, Lodi, $58,223.

ORANGE COUNTY—Between Twentyecond Street and Lampson Avenue, about .0 mile to be graded and surfaced with plantmixed surface. District VII, Route 171, Sections A, B. Sully-Miller Contracting Co., Long Beach, $27,031; J. E. Haddock, Ltd., Pasadena, $28,293; Oswald Bros., Los Angeles, $31,226. Contract awarded to Griffith Co., Los Angeles, $25,967.

SAN DIEGO COUNTY—A 28-foot portland cement concrete bridge over Horse Ranch Creek, 6 miles west of Pala. District XI, Route 195, Section B. Contracting Engineers Co., Los Angeles, $16,923; B. G. Carroll, San Diego, $16,687. Contract awarded to Thomas Construction Co., Burbank, $11,344.

SAN JOAQUIN COUNTY—State Office Building to be reconditioned and additional office space and appurtenances to be constructed. District X. Geo. Rock, Stockton, $2,598; O. H. Chain, Stockton, $2,500. Contract awarded to S. C. Giles, Stockton, $2,264.

SAN LUIS OBISPO COUNTY — A bridge across San Juan Creek about 20 miles east of Paso Robles at Shandon to be constructed. District V, Route 33, Section B. E. G. Perham, Los Angeles, $34,851; Earl W. Heple, San Jose, $35,939; Kiss Crane Service, Berkeley, $36,455; A. Soda & Son, Oakland, $39,790. Contract awarded to Dan Caputo, San Jose, $34,170.

SOLANO COUNTY—At points between 2.5 and 3.5 miles south of Davis, 4 reinforced concrete bridges to be constructed. District X, Route 6, Section A. Louis Biassotti & Son, Stockton, $90,974; J. S. Metzger & Son, Los Angeles, $95,497; E. T. Lesure, Oakland, $95,737; Trewhitt-Shields & Fisher, Fresno, $96,302; Campbell Construction Co., Sacramento, $96,418; A. Teichert & Son, Inc., Sacramento, $100,997; Lee J. Immel, Berkeley, $104,237. Contract awarded to A. Soda & Son, Oakland, $90,932.

VENTURA COUNTY—Grade and surface with plantmixed surfacing 0.3 mile of highway about 1.6 miles west of Saticoy. District VII, Route 9, Section A. J. E. Haddock, Ltd., Pasadena, $15,174; Contract awarded to Griffith Co., Los Angeles, $15,120.

In Memoriam

Douglas Hunter Greeley

February 21, 1897—April 5, 1941

Douglas Hunter Greeley, Assistant District Maintenance Engineer in District VII, Division of Highways, died at Queen of the Angels Hospital in Los Angeles on April 5, 1941.

He was born in Belvedere, California, February 21, 1897, and began work with the Division of Highways, March 6, 1917. Eight months later he became Instrumentman and at the age of 21 became a Chief of Party, one of the youngest men ever to hold such a responsible position.

When District X was separated from District III, Mr. Greeley was appointed Equipment Superintendent for District III. He served in that capacity until 1931 and then moved to District VII, returning to the engineering field for which he was exceptionally qualified.

Possessed of unbounded energy, honesty, and loyalty, and with a personality that made friends of all whom he met, he received various promotions until at the time of his death he was Assistant District Maintenance Engineer in District VII.

He carried his energy into his hobbies, was interested in aviation, and was an enthusiastic photographer, using his skill to record his work and to entertain his friends.

He is survived by his wife, a son, Douglas, and his mother, Mrs. Rozeltha Hunter Greeley.

His passing leaves a void in District VII that will not soon be filled.

"His life was gentle, and the elements so mix'd in him that Nature might stand up and say to all the world 'This was a man!'"

Pan American Highway is Nearing Completion

One of the most important instruments in the development of international tourist travel and friendship in the Western Hemisphere—the Pan American Highway—is well on the way to completion says a report of the Public Works Administration. Three-fourths of the South American section extending from the Colombia-Panama border to Buenos Aires, Argentina, is now passable during all seasons of the year.

An accompanying map, the first ever issued, shows the condition of the 8,097 mile road as of September, 1940. The paved portion totals 2,015 miles or 25 per cent; all-weather surfaces, 4,147 or 51 per cent; dry weather surfaces, 1,646 miles of 20 per cent; and trails, 289 miles or 4 per cent.

The original route runs from the Atrato River in northwest Colombia to Valparaiso, Chile. From Valparaiso it goes east to Santiago and thence over the Andes by the Uspallata Pass, where stands the world-famous statue, the Christ of the Andes, and thence to Buenos Aires. This route is 5,757 miles long.

The alternate route, some 324 miles shorter, leaves the West Coast road at Vitor, Peru, crosses the Andes by way of Lake Titicaca to La Paz, Bolivia.

Extending Arroyo Seco Parkway Into Los Angeles

(Continued from page 8)

Earth cuts 100 feet or more in height are involved on this project. The balancing of cuts and fills was not possible because of the topographical and geological grade controls to be met.

Incidental to the highway work is the reconstruction and enlargement of the Elysian Reservoir operated by the Los Angeles City Department of Water and Power. The highway in this area will be on the downstream toe side of the dam and will be part of the earth dam structure. This work with lining and appurtenances will cost about $217,000 of WPA and city funds.

The project will provide a comprehensive plan of landscaping to be cooperatively financed by the City of Los Angeles Park Department, the WPA and the State. This will result in the complete development of the park lands adjacent to and visible from the freeway.

Approximate estimates of construction costs of various units showing the construction agency follow:

L. A River, Substructure	$270,000	WPA.
L. A River Superstructure	400,000	State, City Contract—Federal Aid, State
Castelar St Separation	68,000	Contract—Federal Aid, State
Amador Street, Separation	25,000	Contract—Federal Aid, State
Bishop Road Separation	60,000	Contract—Federal Aid. State
Park Row Separation	30,000	Contract—Federal Aid, State
Solano Street Separation Substructure	25,000	WPA
Solano Street Separation Superstructure	30,000	Contract—Federal Aid, State
Grading, paving and landscaping	1,318,000	WPA
Elysian Reservoir Enlargement	217,000	WPA
	$2,437,000	

The substructure of the Los Angeles River bridge is being constructed by WPA at an estimated cost of $270,000. Work on the smaller piers is now in progress. As soon as flood danger is over work will start on the two large river piers. The removal of existing heavily reinforced concrete channel walls to permit the construction of the foundations of the river piers will be a difficult operation. Although these piers will not be ready for placing the deck until about November, 1941, other piers will be ready for the superstructure about July, 1941.

This bridge should be finished about the summer of 1942 which should coincide with the completion of the roadway grading, paving and landscaping. In other words the Extension may be opened to traffic in the summer of 1942.

If a Bridge Could Speak

Mr. W. A. Macdonald, publicity representative of the Government Travel Bureau of British Columbia, attended the dedications of the Eel River and Smith River State highway bridges. Impressed by the grandeur of the redwoods in Humboldt and Del Norte counties and the new spans of modern structural design he wrote the following for California Highways and Public Works:

I am a bridge.

I am made of steel and concrete.

Because I am a new bridge I am made of the finest materials and the utmost design that marks modern engineering achievement.

I am built for beauty that the greater beauties of nature may be more fully enjoyed.

I am built for safety in order that your enjoyment may not be marred through any fault of mine.

I permit easier access between communities and thus promote the spirit of neighborliness.

I am a bridge—a new bridge—a fine bridge.

I am a symbol.

My structure and design are symbols of American progress.

I am a symbol of man's appreciation of beautiful things, both in the things of his own creation and in God's handiwork in Nature.

I am a symbol of man's awareness of the dangers that beset his brothers—a symbol of man's efforts to lessen those dangers.

When men meet in the center of my span, far above the rushing torrent, and when they clasp hands in friendship and understanding, they may know that the great human heart of true Americans can always rise above and conquer threatening force, for I am a symbol of the greater power of a people united for the common good.

The giant redwood trees whisper in their spiring antiquity. They look down from their ages of possession upon our brief stewardship of this great land. They look down upon me—a new bridge—and upon you, the guardians of this great land. They see in me, not just a structure of steel and concrete, but a symbol of things which will endure, even as they have endured. And may it be said that they see in you those qualities of loyalty, integrity, and unity that will overcome all obstacles in assuring the great destiny of the land that bore them.

I am a bridge.
I am a symbol.

Highway Crews Win High Praise for Storm Work

"TOO much praise can not be given the members of the State Highway Division's maintenance crews—at least in this part of the State, and they probably are representative of the entire force for their splendid fight against the elements in the recent period of flood," says the Santa Maria Times.

"No matter how hard the rain was falling, travelers found the highway crews at work, day and night. Bulldog machines were pushing huge piles of mud, sand or gravel off the pavements at dangerous points, trucks were hauling the stuff away, where it could not otherwise be disposed of temporarily; flagmen, in slickers and storm hats were directing traffic and warning of danger, signs and flares were rushed out to points where caution in driving was necessary, and work seemed to go on 24 hours out of every 24, smoothly, carefully, efficiently.

"As a result of this, under great odds, Highway 101 was kept open between Santa Maria and Santa Barbara; the same road north of the city was often freed of sand, gravel and slime, and the roadbed was guarded at the Santa Maria bridge against a mounting floodtide in the river, and difficult Cuyama highway was kept open except for a brief period when a bridge approach was washed out.

QUICK WORK RESTORED THIS BRIDGE

"Over the Bakersfield-Fresno road near Cholame, a similar battle was in progress. The highway was under water and mud in many places, but crews kept the mud back so that cars could get through and kept traffic moving through a mountain area until the swirling waters finally cut out the supports and dropped two spans of a concrete structure into the streambed.

"While it was a huge job to install a redwood flume of sufficient size to carry that flood of water and then cover it with earth and gravel, it was not a week, until the by-pass had been finished in pouring rain."

State of California

CULBERT L. OLSON, Governor

Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

FRANK W. CLARK, Director of Public Works

FRANZ R. SACHSE, Assistant Director

MORGAN KEATON, Deputy Director

CALIFORNIA HIGHWAY COMMISSION

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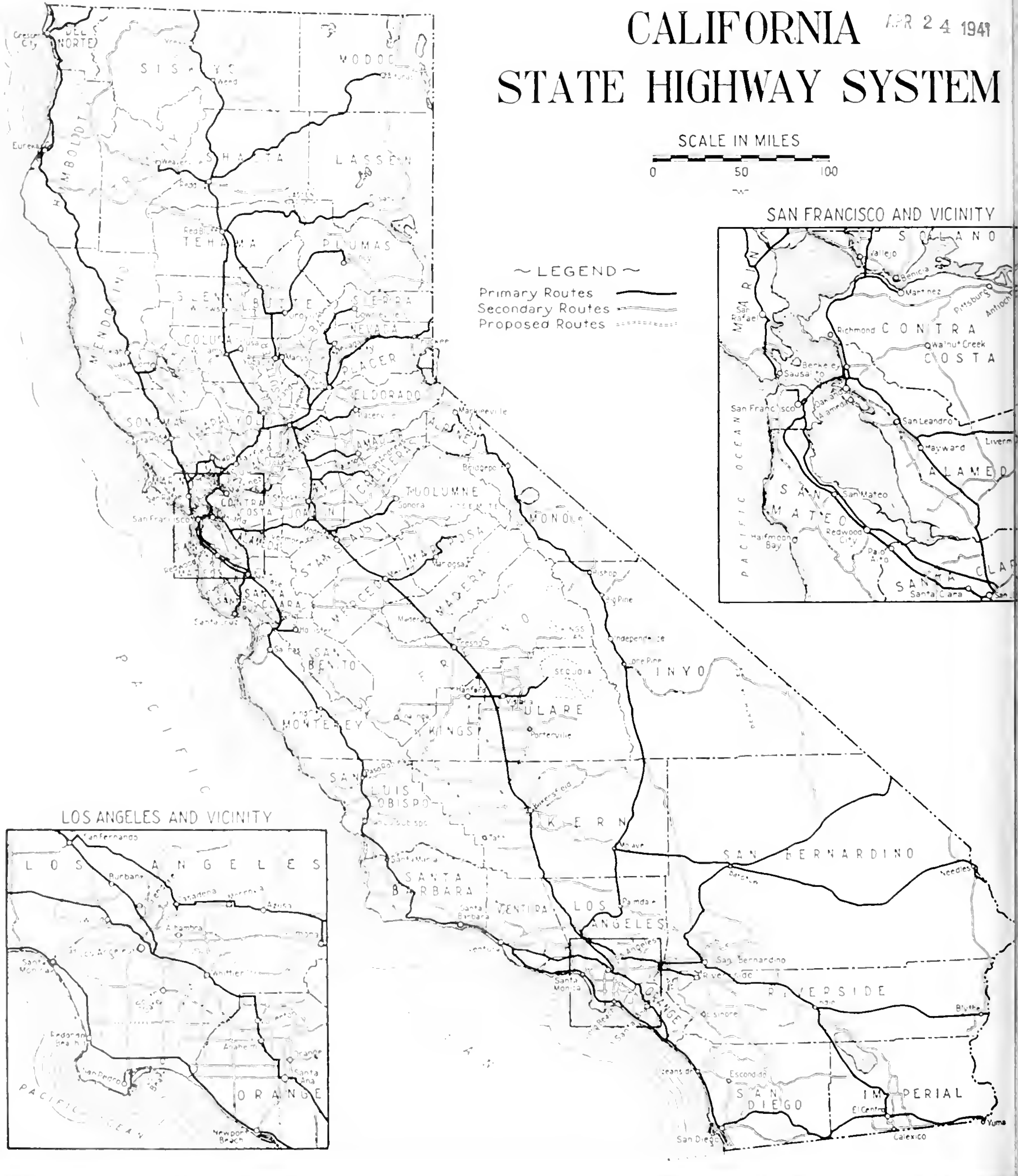

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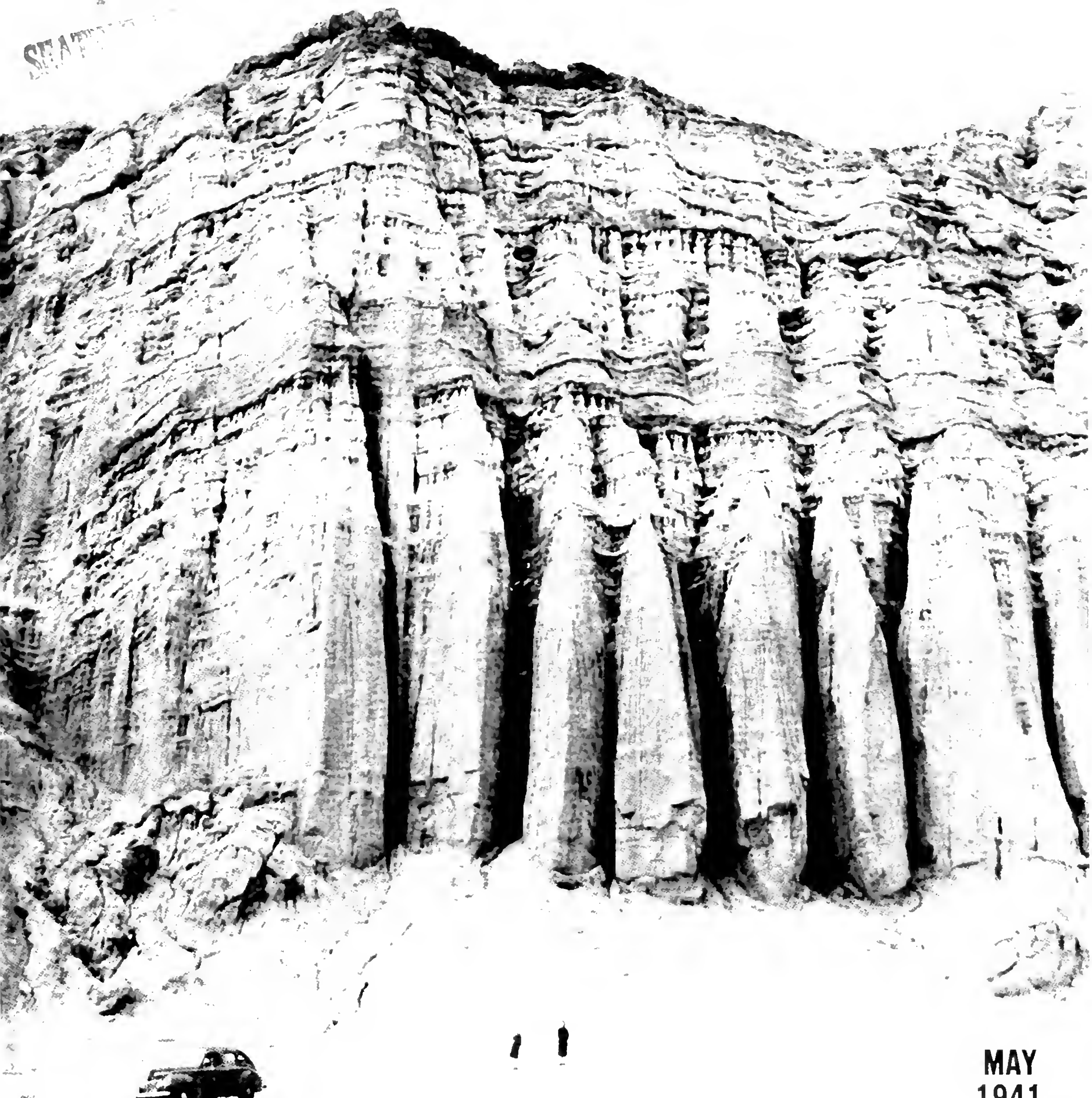

MAY
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THE "KNEELING NUNS" OF RED ROCK CANYON (U.S. 6) KERN COUNTY
(SEE ARTICLE IN THIS ISSUE)

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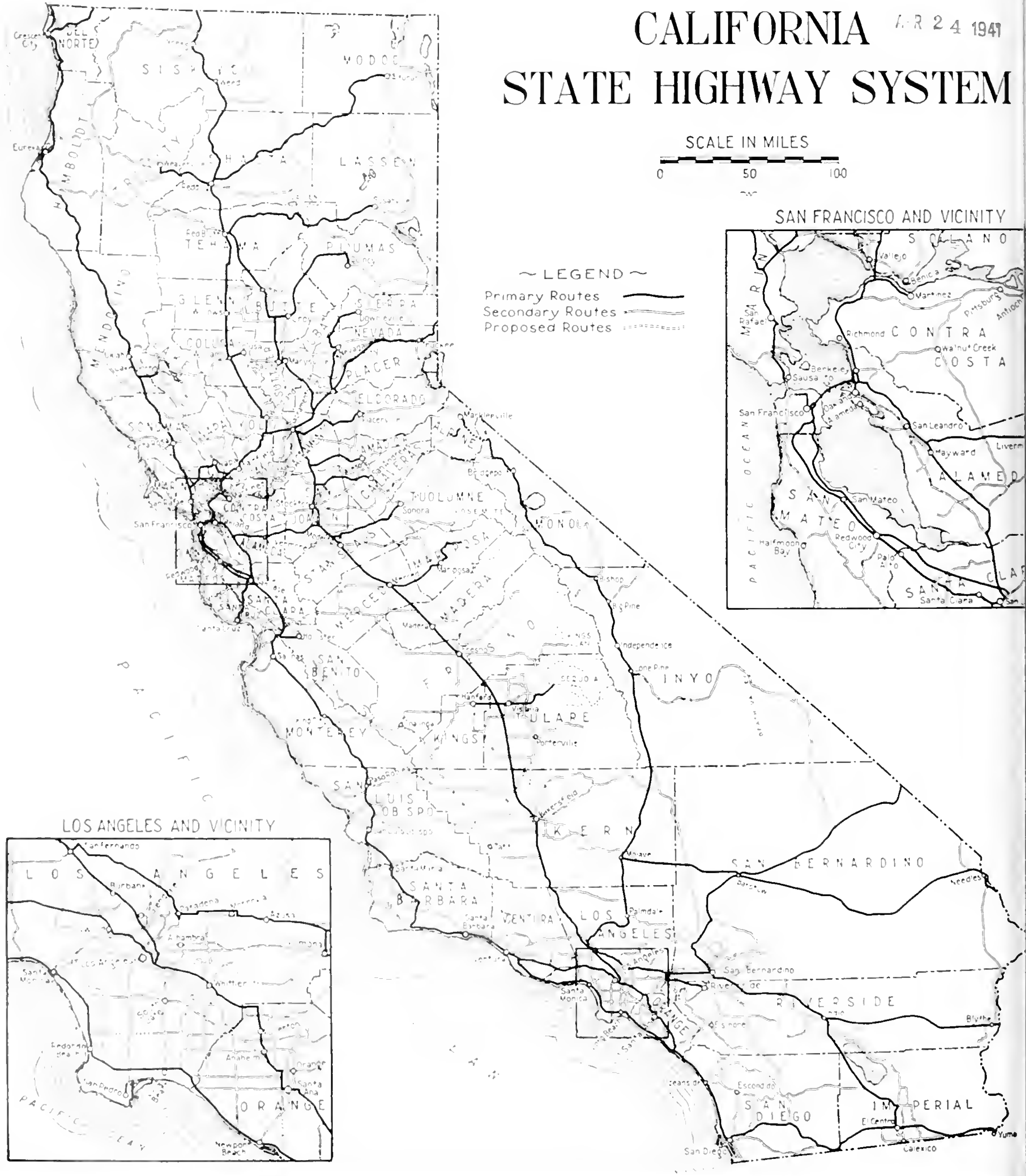

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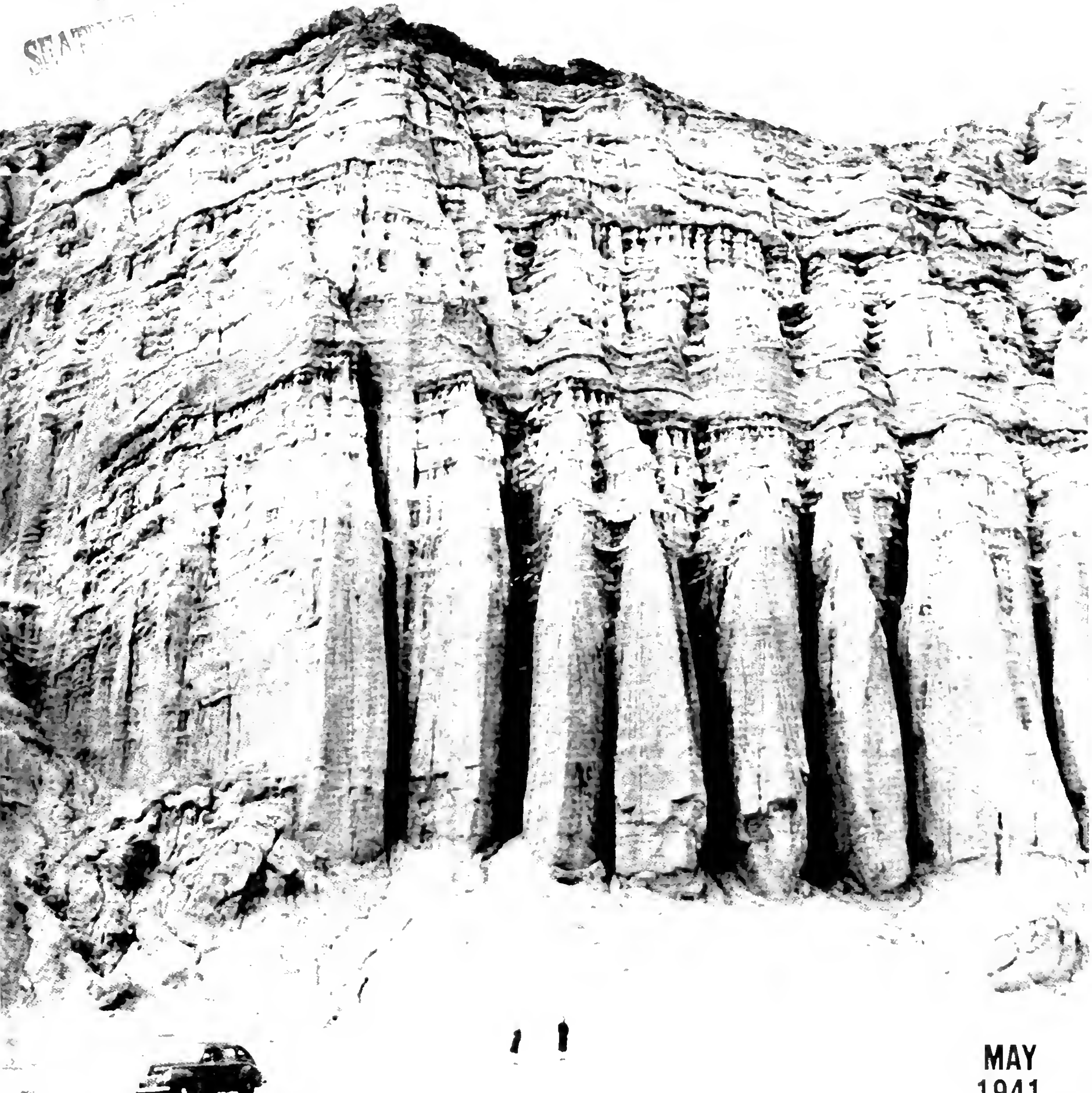

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FRANK W. CLARK, Director C. H. PURCELL, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate E

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There is available for apportionment for this fiscal year $25,964,577 after refunds of $4,811,557.70 and expenses (of the State Controller and Board of Equalization) amounting to $201,668.87 are deducted.

Of the amount available for apportionment, the counties this year will receive $17,309,718.53 as compared with $16,652,561.22 last year.

Out of the gas tax revenues for the fiscal year, the Division of Highways under the law must give $8,654,859.28 to incorporated cities, the State receiving 1½ cents of the 3-cent gas tax funds available for apportionment, the counties 1 cent and the cities ½ cent.

The total revenue subject to allocation actually is divided 50-50 between the State and the counties and cities combined.

There will be apportioned to the cities and counties for the fiscal year a total of $25,964,577.81 as compared with $24,978,841.82 apportioned to these subdivisions for the fiscal year which ended June 30, 1940 making a grand total of $50,943,419 for the current biennium. The total for the 1937-39 biennium was $46,818,669 showing an increase of $4,124,750 to cities and counties for the current biennium.

The apportionment to counties is determined in the following manner:

1) Each county first receives a minimum of $7,500.

2) The remainder is apportioned to the counties in the proportion that the registration of vehicles in each of such counties bears to the total vehicles registered in the State.

Section 194 of the Streets and Highways Code requires that the net revenue from ¼ cent per gallon of tax or ⅙ of the amount paid into the State Highway Fund be expended for the construction, improvement or maintenance of city streets of major importance other than State highways. The apportionment to the various cities of the State is made on the basis of population as determined by the last Federal census.

Section 203 of the Streets and Highways Code requires the expenditure of another ¼ cent of net revenues on State highway routes within cities. This apportionment to the several cities is also made on a population basis. Apportionments this year are based on the 1940 census figures.

With the April payment of the ¼ cent gas tax the sum of $4,327,429.63 was distributed to the 285 incorporated cities in California for expenditure upon streets of major importance other than State highways for the fiscal year ending June 30, 1941.

This represents a gain of $164,289.33 over the distribution of $4,163,140.30 during the 1940 fiscal year or an increase of 4 per cent.

An equal amount was distributed for expenditure upon State highway routes within the limits of incorporated cities during the period July 1, 1940, to June 30, 1941.

A tabulation of the amounts allocated to each city during each of the fiscal years ending June 30, 1940 and June 30, 1941, respectively, for expenditure upon streets of major importance together with the amount apportioned for expenditure upon State highways in cities during the two-year period, will be found on pages 14, 15, 16 and 17. The amounts distributed to each of the counties will be found in another list to be published in an ensuing issue:

(Continued on page 14)

Apportionment of Gas Tax Revenues

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(Continued on page 14)

Redwood Highway on Eel River in Humboldt County damaged by flood waters where timber deflectors have been placed to protect bank

Redwood Timber Deflectors Built as Bank Protection on Eel River

By WALDO H. CHASE, Resident Engineer

THE recent construction of four large redwood timber deflectors and appurtenant structures on the Redwood Highway in recent flood control work on the Eel River in Humboldt County is of especial interest.

Three of these deflectors were erected at Greenlaw Bluffs, about five miles south, and one at Shively Bluffs, about ten miles south of Scotia, California, during the Fall and Winter of 1940-41, to repair damage caused by floods on the Eel River during the month of February, 1940, and to provide protection against future high water.

The State Highway through Greenlaw Bluffs was constructed in 1915 and reconstructed in 1931. In December, 1937, a section of this highway was damaged by floods and a contract was let for the construction of a gravel embankment protected by sacked concrete riprap. During the flood of February, 1940, the river reached to within three feet of the maximum flood of 1915 and, while the recently constructed riprap withstood the flood, there was an excessive scour beyond the downstream limits of this work and sections of the highway were badly damaged.

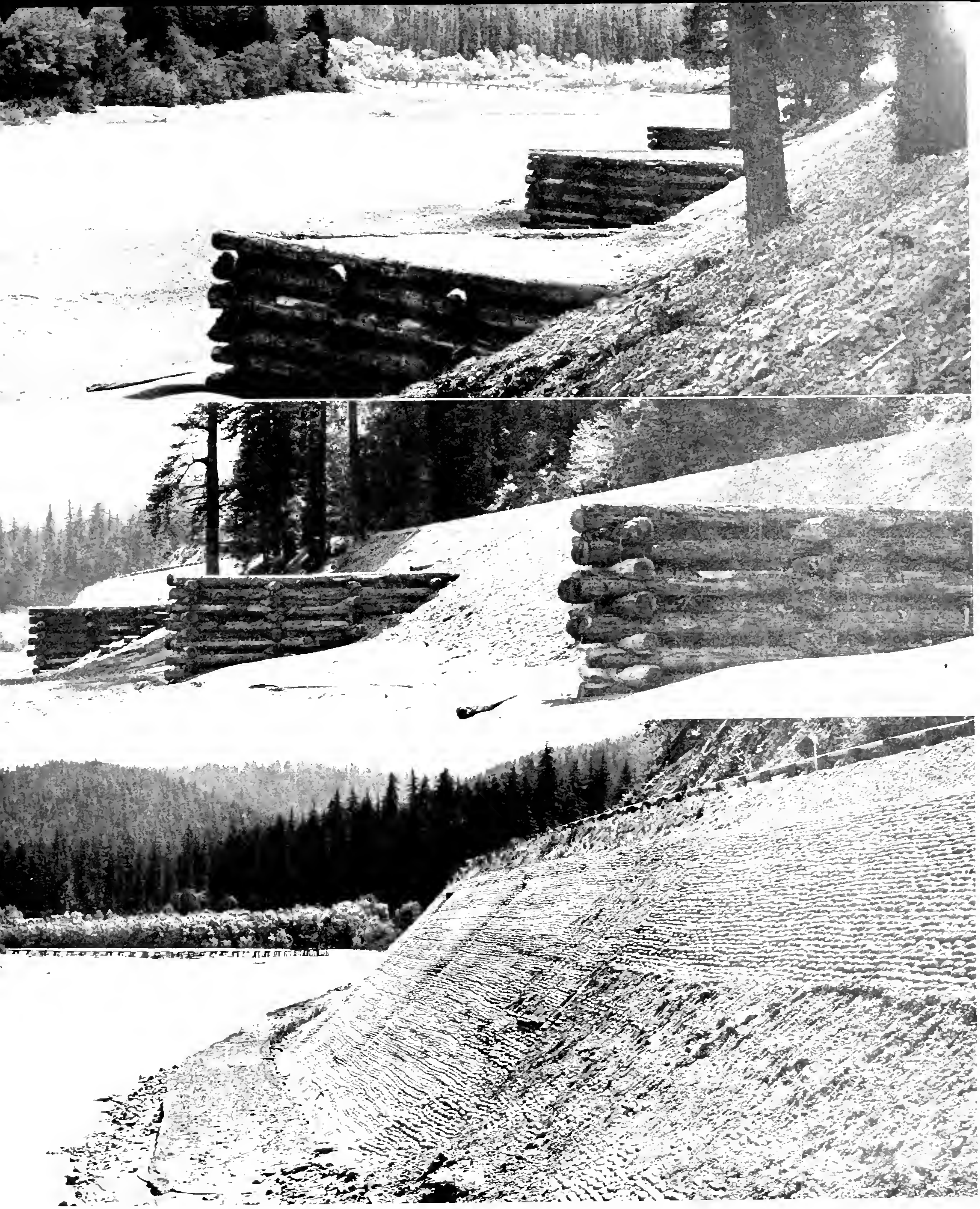
EDDY DESTROYED BANK

It is considered that, due to the smooth surface of the riprap as compared with the natural river bank, the velocity of the stream was greatly accelerated and upon reaching the end of the riprap, where the tendency was to retard in velocity, a severe eddy was formed and the destruction of the bank was started.

Heavy rains had saturated the bank and it therefore melted away rapidly. The damage at this location extended a distance of seven hundred feet along the highway.

At Shively Bluffs the extent of the damage covered a distance of approximately one hundred feet where the embankment broke back to an old mat of timber which had evidently been placed as a corduroy and was some twenty feet beneath the surface of the existing road surface. Water was seen to be flowing from around this old timber and it is considered that this condition contributed to the failure at this location.

After due consideration it was decided that the construction of large timber deflectors extending to foundations well below the stream bed, and lined with heavy galvanized chain wire mesh filled with coarse gravel would provide the most feasible protection for these locations.



angular timber deflectors protecting banks and Redwood Tree groups shown above. At bottom riprap section that successfully withstood flood currents.

The contract for this work was let on August 21, 1940, and, with the exception of plant-mixed surfacing and other minor items, the work was completed on January 31, 1941. It is contemplated that the surfacing will be completed this month.

REDWOOD LOGS USED

The excavation for the deflectors was carried to an elevation ten feet below the normal level of the river and the foundation grade was carried in steps, from two to four in number, to the inside or bank face of the deflectors.

In designing the timber deflectors the size of redwood logs to be used in the structures was limited to a minimum diameter of twenty-four inches. Logs were procured from several locations in the vicinity of the project, averaged twenty-seven inches in diameter and were exceptionally well graded.

The logs were framed at the site of the work and were erected by means of power hoists and tractors. One-inch galvanized steel drift pins were used at all joints, two being driven through each log to a minimum depth of twelve inches into the log beneath. Electric and air drills were used in setting all drift pins.

This method of drifting provided four pins at each joint as the alternate operations cause the drift pins to overlap those previously driven. Drift pins were driven flush with the top dap of the logs and countersunk where necessary to obtain the twelve-inch minimum penetration.

The placing of logs was started at the points of the deflectors and consisted first of a row of stretchers and proceeded in alternate tiers of headers and stretchers. The first logs to be placed on each succeeding step consisted also of stretchers.

TRIANGULAR IN SHAPE

The points of the deflectors were constructed in the shape of an equilateral triangle while the back portions were of rectangular shape. The headers in the rectangular portions were offset from the headers in the point in order to maintain a uniform succession of tiers throughout each structure.

The deflectors were completely lined with galvanized 9-gauge chain wire mesh with two-inch openings and were filled with screened gravel of two-inch minimum size. The wire mesh was

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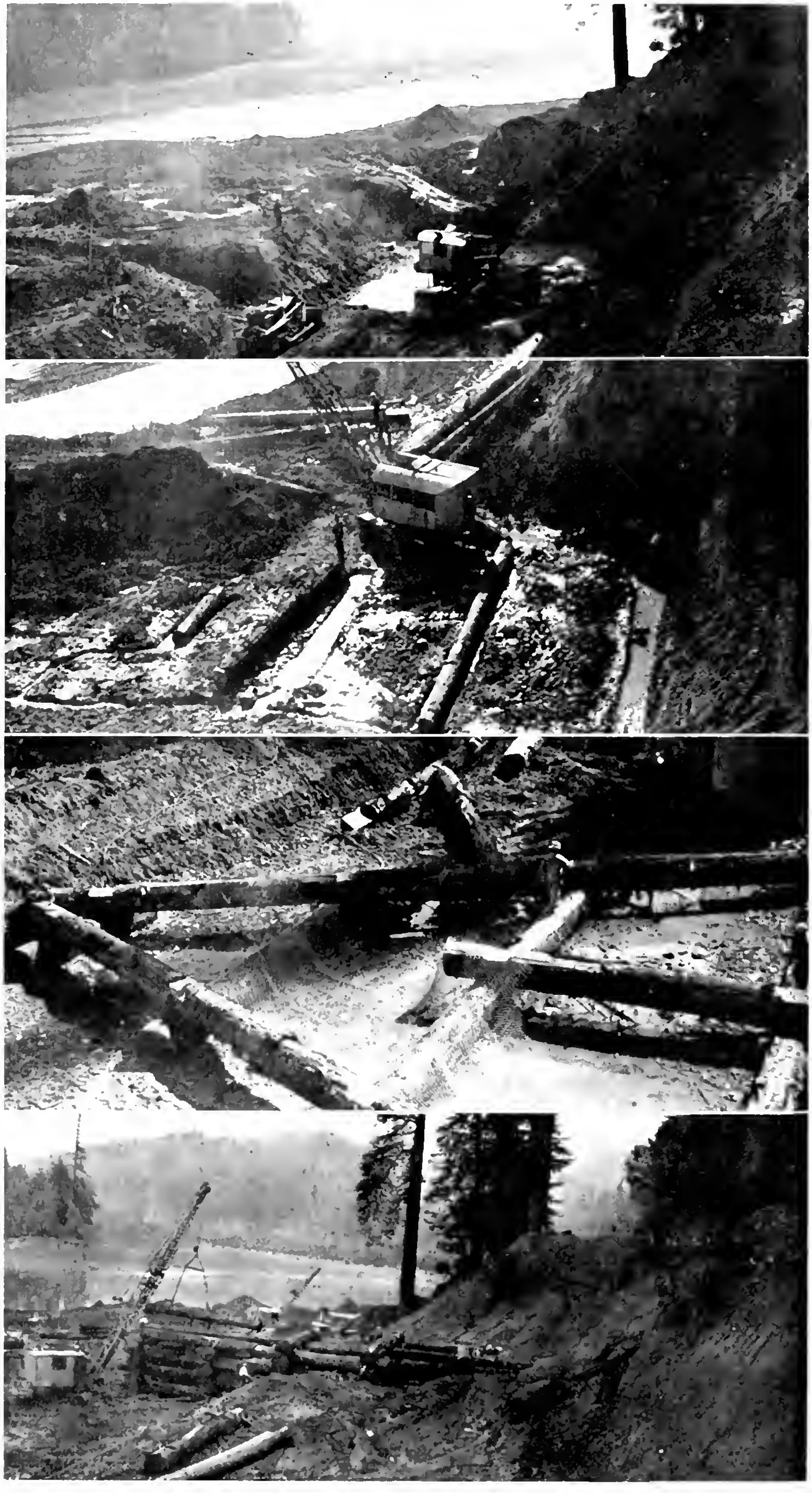

Pictures of deflector construction with 27-inch redwood logs from the foundation excavation to the completed structure filled with screened gravel of two-inch minimum size

Carmody Recommends $287,000,000 for National Defense Highway Work

CALIFORNIA will receive Federal aid in the amount of $3,-982,125 for construction of Vational defense highways if Con-ress approves recommendations for ppropriations totaling $287,000,000 or immediate defense highway con-truction, submitted to President Roosevelt by John M. Carmody, Fed-ral Works Administrator.

In this connection, the California)ivision of Highways has estimated hat there will probably be a total f about 300 miles of access roads esignated in this State and that the pproximate costs for construction nd right of way to improve these oads will amount to about $28,600,-00. As most of this access mileage s situated off the State highway ystem, expenditures of State high-vay funds for right of way and im-rovements are prohibited by Cali-ornia statutes.

LEGISLATURE CLEARS WAY

This is a problem with which the)epartment of Public Works and arious counties of the State were reatly concerned but a bill passed by he State Legislature and signed by overnor Olson has now cleared the ay for California to begin construc-ion of access roads to numerous mili-ary camps, cantonment training fields nd establishments as soon as Con-ress allocates the necessary funds.

Passed as an emergency measure, enate Bill 679 empowers the Depart-nent of Public Works to enter into an greement with the United States for e performance of the necessary right f way, acquisition and construction ork on military roads even though uch roads may not be on the State Iighway System.

The department will be authorized o acquire right of way at the ex-ense of the Federal Government and o convey title to the United States.

SOME WORK UNDER WAY

The United States having requested he department to construct these oads, engineering studies on many of hem are now in progress and the State has actually begun work on some of them with WPA funds found available.

The Federal Government wishes to handle such projects in the same manner as the State handles county feeder road projects not on the State Highway System, that is, the State department does the work and obtains reimbursement from the Federal Government when the work is completed.

These military projects will differ from the feeder road projects in that the counties contributed part of the cost of the feeder roads whereas under this bill the Federal Government will provide the entire expense when the project is not on the State system.

BASED ON SURVEY

Mr. Carmody based his recommendations to the President upon a survey of highway facilities from the viewpoint of National defense, made by the Public Roads Administration in collaboration with the Advisory Commission to the Council of National Defense and the War and Navy Departments.

The report urges an appropriation to the Public Roads Administration of not less than $150,000,000 for access roads to military and naval reservations and defense-industry sites. This sum, the report says, should be available to pay all costs, including right of way, of roads in the vicinity of reservations and industrial sites when such roads are certified to the Federal Works Agency as essential by appropriate major defense agencies. It should also be made available, says the report, to pay the cost of constructing new sections of highway, replacing existing highway connections broken by necessary closure at reservations and industrial sites.

The Public Roads Administration recommends other appropriations as follows:

Twenty-five million dollars to be used for the improvement of roads which will be required regularly in the tactical maneuvers of the Army and for the reimbursement of the out-of-pocket costs to States and local governments for repairs necessitated by the occasional use of roads for these purposes.

$100,000,000 FOR BRIDGES

One hundred million dollars to provide for the replacement of substandard bridges and the correction of other critical deficiencies of the strategic network at a desirable rate. This appropriation, says the report, should be prorated to the States on the existing Federal Aid basis and used solely for designated defense projects. It should be available, the report says, to pay all legitimate costs of the projects on a somewhat higher basis of Federal participation than the existing fifty-fifty basis, but otherwise should be expended under the provisions of the Federal highway legislation.

The Bridge Department of the Division of Highways estimates that nearly half the bridges on the military highway network in California will have to be replaced, widened or strengthened in order to bring them up to the standards required by the War Department. There are about 1,500 bridges on this network, 200 of which should be replaced and 500 more strengthened. The cost of this, exclusive of any road approach work, would amount to about $12,-000,000.

EXTENSIONS THROUGH CITIES

The P.R.A. report submitted to President Roosevelt also urges an appropriation of twelve million dollars for the making of engineering surveys and plans for development of the strategic network, including the extensions of the system into and through municipalities and metropolitan areas; this appropriation to be prorated to the States and matched by them on the existing Federal Aid basis.

The Public Roads Administration recommends that to accomplish all necessary defense improvements, the Federal Highway Act should be amended to (1) authorize addition to the Federal Aid system of any

(Continued on page 19)

Scenic sector of U. S. 6 through weirdly eroded, colored sandstone cliffs of Red Rock Canyon on Mojave Desert

Traffic Hazards Eliminated On U.S. 6 Highway In Kern County

By S. W. LOWDEN, Acting District Engineer

A SERIES of traffic hazards has been eliminated from the Los Angeles to Reno Highway on East-of-the-Sierra route in Kern County by means of the recent completion of a contract extending from twelve miles north of Mojave to Ricardo. Ten consecutive hazardous dips have been rendered innocuous except perhaps for the duration of periods immediately following the most unusual and serious of flash floods.

State Sign Route 23 (U. S. Route 6) constitutes in part the most direct highway leading from Los Angeles to Reno, following the easterly base of the Sierra-Nevada Mountains for 100 miles. It serves as the main outlet to a vast region covering a large portion of eastern California, western Nevada, and major portions of the States of Oregon, Washington, Idaho and Utah.

The southerly portion of this route on which the improvement is located is on the highway leading to the westerly entrance of the Death Valley National Monument, and to the easterly entrance to the Yosemite National Park, also affording access to the High Sierra recreational regions.

RECREATIONAL TRAFFIC INCREASING

Until recently this route was of minor importance during the winter season. However, with the rapidly increasing recreational use being made of the Inyo-Mono area, and the rapid strides being made in methods affording ease of access under the most adverse winter conditions, it is found that winter traffic is continuously increasing and that a reasonably uniform traffic flow is experienced throughout the year.

The nature of the terrain permits the construction of a highway to high standards with minimum grades and long, unobscured tangents which, together with the existence of but few small towns, results in what is possibly the highest sustained speed highway in the State on the 350 miles between Lancaster and the California-Nevada State Line near Minden, Nevada.

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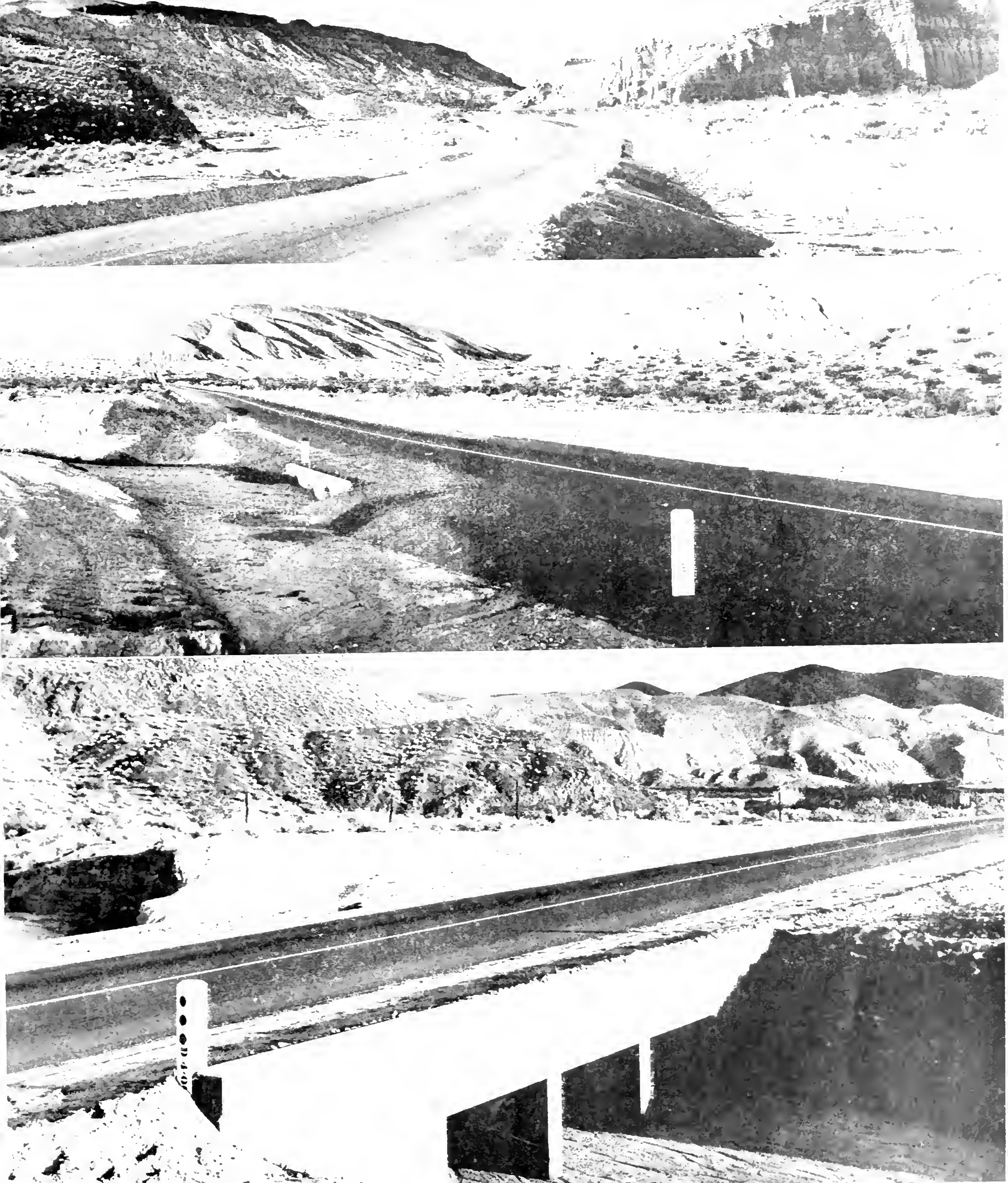


Views of sections of U. S. 6 Highway through Red Rock Canyon improved and made safer for traffic by elimination of dips. At top, dip replaced by fill and culvert. Center, a three pipe battery culvert and at bottom a triple box culvert

Public Spirited Citizens Beautify A State Highway Parkway Strip

By W. F. AXTMAN, Asst. District Maintenance Engineer

ANOTHER public spirited citizen who should be known throughout our State of California is W. Carl Spencer of Costa Mesa in Orange County, for he is the man who is mainly responsible for the planting and beautification of the parkway strip down the center of Costa Mesa's business street and probably several other civic improvements of which he is too modest to tell.

This parkway planting at the present time extends for over one-half mile along State Route 55, Newport Boulevard, through the center of town and is from ten feet to fifty feet in width.

The area planted is on abandoned railroad right of way that in the earlier days carried the tracks of the Southern Pacific Company's line from Santa Ana to Newport but has since been acquired by the State of California as highway right of way. It now serves as a parking area and a separating parkway between the two sides of the divided business street.

SUGGESTED NAME CONTEST

Mr. Spencer's interest in the civic affairs of the town commenced as soon as he arrived there as a rancher twenty-three years ago. It was then called "Harper," a small Orange County village thirty-five miles from Los Angeles, and three miles inland from Newport Beach, with a population of only a few hundred.

Situated as it was, near the sea but on a mesa high above the beach and favored with a delightful climate and fertile soil, Mr. Spencer felt that the town should have a more descriptive name. He, therefore, organized and headed a group of townspeople and went to work campaigning for a new name. A contest was held, a $25.00 prize offered, and as a result the name "Costa Mesa" was chosen.

Thirteen years ago he started his city beautiful program. A committee was formed and community help solicited. To inaugurate the program a benefit concert, sponsored by Mr. Spencer, was given at the school auditorium so that the citizens might contribute, if they wished, to the fund for beautifying and improving the old railroad right of way.

STARTED WITH A CONCERT

The purpose of this first concert was printed on the program and read as follows:

"At last the movement is launched, a gesture which indicates that local civic pride is forming to accomplish definite results along the line of culture, harmony and beauty.

"That community scar, the Southern Pacific right of way, as every observant tourist (and some local citizens) has noted, has up to now been almost wholly under the supervision of General Neglect whose ugly duckling technique of landscaping consists in humps and hollows, weed patches, 'dead soldiers' and brick bats, totem poles and old bill boards.

"Your Beautification Committee thinks that General Neglect should be removed and, there being no life in him, embalmed and laid away for reference as a melancholy example of all around incompetence.

"Your Beautification Committee further proposes to employ Professor Art-Harmony and aides to transform this right of way scar into a thing of palms, shrubbery, hedges, lawns and flowers."

To the proceeds from this concert Mr. Spencer added funds of his own, as well as his time, and a block long section of the work was begun.

STATE ACQUIRES PROPERTY

Plans for building a superhighway from Boston to Washington estimate the cost at $253,000,000 for 105-mile length with 12 lanes in dense traffic regions.

Palms, shrubs and flowering plants were set out and when the first section was completed it was so thoroughly enjoyed by local residents and so warmly commended by visitors and tourists that later another section was planted. Still another portion was improved in 1938 and today over one-half mile has been beautified. However, according to Mr. Spencer, his project is far from being completed for he has plans already prepared for still further planting in the future.

ONE HUNDRED SHRUB VARIETIES

Besides many flowering plants, such as ivy leaf geraniums, marguerites, etc., over 100 varieties of shrubs and six varieties of palms are growing in profusion. Some of the palms have been donated by other public spirited citizens but Mr. Spencer has propagated many from seed. Even the rare Chinese Tung tree, from which tung oil is obtained, will be found there. This tree is covered with pink blossoms in the spring and adds an attractive bit of color to the park.

Mr. Spencer thoroughly enjoys his work. He devotes considerable time and money to it but feels repaid not only by the pleasure he receives from doing it, but by the pleasure and satisfaction it gives to local residents and visitors.

141 Cities Placed In Safety Honor Roll

For going through the entire year of 1940 without a single traffic fatality, 141 cities with populations between 5,000 and 10,000 have been placed on the honor roll of the National traffic Safety Contest.

The National Safety Council, which conducts the contest, announced that this marks a decrease of 38 cities from the 1939 honor roll.

Each of the cities will receive a certificate of commendation in recognition of its outstanding work in the traffic safety field. A total of 1,281 cities and 48 States were entered in the various divisions of the contest.

In California the following cities were listed: Corona, Orange, Martinez, Montebello, Coronado, Santa Maria, Santa Paula and Pacific Grove.

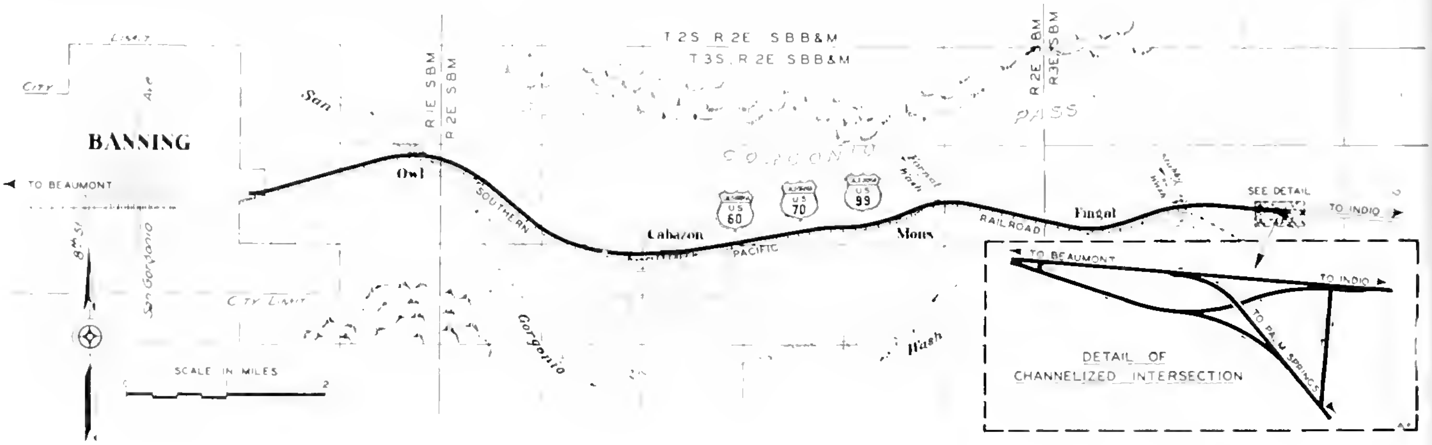
Views of parkway in Costa Mesa business street planted by public-spirited citizens. No. 4 shows how it looked before plantings

New Divided Highway Channelizes Traffic at Palm Springs Junction

By A. EVERETT SMITH, Assistant Resident Engineer

AN eleven-mile project now under way, comprising construction of a 4-lane divided highway, begins at Banning in Riverside County and extends easterly on the combined U. S. Highways 60, 70 and 99 to the Palm Springs junction near Whitewater. It is a companion project to the one recently opened to traffic from Beaumont to Banning.

Like the Beaumont-Banning project, this one also utilizes the existing pavement for one-way traffic. Two new traffic lanes have been constructed to carry the opposing traffic, on a separate grade line with a dividing space left between the old and the new dual lane roadbeds.



Sketch map of new divided highway between Banning and Palm Springs Junction showing channelization detail

The principal features of this work consist, in general, of grading the new roadbed, placing a cement stabilized base and topping with plant-mixed surfacing. Five reinforced concrete bridges have been constructed, and a reinforced concrete grade separation structure was built at the east end of the job as a part of the channelized intersection at the Palm Springs junction.

Work was commenced May 15, 1940 and good progress has been made despite unusually heavy winter rains.

This project was designed to meet the ever increasing difficulties caused by rising volumes of truck and passenger traffic. This being a portion of the direct route between the Los Angeles Metropolitan Area and the Imperial Valley, it is used extensively as a trucking route.

Many of the truck units are of maximum legal dimension and weight capacities. Large volumes of transcontinental traffic converge on this route from State entrances at Blythe and Yuma. During winter and early spring seasons, recreational traffic is particularly heavy, due to desert winter resorts and scenic attractions.

The existing highway is on a grade descending easterly from an elevation of 2,220 feet at the east city limit of Banning to 1,260 feet at the Palm Springs junction. Heavily laden trucks west bound are forced to use lower gears resulting in slow speeds. Due to the difficulty involved in passing, these slow vehicles on a two-lane highway against opposing traffic, long lines of automobiles have in the past formed behind the trucks, thus impeding normal traffic flow and materially increasing traffic hazard.

The design of this project in providing two traffic lanes in each direction with an intervening dividing strip will permit the higher speed vehicles to pass the slower units without interference from oncoming traffic. The west bound traffic will in general use the newly constructed portion of the highway while east bound traffic will use the existing pavement.

At the easterly terminus of the project a channelized intersection has been completed and opened to traffic. Previously, the Palm Springs to Los Angeles traffic crossed the Los Angeles to Indio traffic at grade. As both of these traffic movements are heavy in volume and fast in character, traffic congestion and the resulting danger element often resulted. This was especially apparent during winter months when traffic to Palm Springs and the desert areas is the heaviest.

HAS CHANNELIZATION SYSTEM

The new intersection system has separate channels for the various interchanges of traffic to provide a smooth uniform flow. A grade separation structure carries the traffic from Palm Springs over the east bound traffic on U. S. 99. A flashing light system has been installed at the ends of central dividing curbs where traffic is separated into the dual roadway sections.

In addition to the reinforced concrete grade separation structure five reinforced concrete girder bridges

At top. One way traffic channels separate Indio and Palm Springs traffic at junction point. Overhead structure at left carries Palm Springs northbound traffic. Center. Section of new one-way road-bed. Existing roadway on left. Bottom. Spreading cement stabilized base. Bulldozer pushes laden truck, spreads material while dumping and pulls timber drag behind have been constructed across the main drainage channels leading from the San Gorgonio Mountains to the north. A total of 14 main spans plus four shorter cantilever spans were involved, and the total combined length of the bridges is 525 lineal feet.

Sacked concrete riprap was used at the ends of the San Gorgonio Wash Bridge and the Fornat Wash Bridge to protect the enjoining embankments from storm damage.

CEMENT STABILIZED BASE

A cement stabilized base was placed on the subgrade varying in thickness from six inches on the left adjacent to the dividing curb to nine inches at the shoulder line. The base material used here was similar to that covered in the March issue of this journal for the Beaumont-Banning project.

Local material obtained from a channel of the San Gorgonio Wash, was mixed with cement and water at a plant located adjacent to the wash, and transported to the street in dump trucks. The material was spread with a 95 horsepower tractor with a bulldozer attachment. Forward steel plate wings were placed at the ends of the bulldozer blade and mounted on wheels adjustable for height by means of screw jacks. The truck was pushed by the tractor and the material was spread to the required depth as it was dumped from the truck.

On this project, in contrast to the Beaumont-Banning project, a heavy timber drag was pulled behind the bulldozer to shape the mixture preparatory to rolling. The drag was made of 6 by 6 inch timbers set diagonally across the roadway to the full width of the base. Shorter cross diagonals were set at an angle to the timbers to obtain a uniform distribution of the material.

Behind the drag a three-wheel roller followed by a pneumatic multi-tired roller was used to obtain compaction. A curing seal consisting of Liquid Asphalt RC-1 was applied immediately after the rolling operations.

At present, the contractor is completing the placing of plant-mixed surfacing 0.21 foot in thickness over the stabilized base and shoulder.

The work is being performed by George Herz and Company, contractors. Mr. G. E. Malkson is the Resident Engineer.

Sacked concrete riprap was placed at the ends of the bridge over San Gorgonio Wash to protect the adjoining embankments from storm damage

Spreading cement stabilized base. Note forward steel plate wing on bulldozer blade is mounted on wheel with screw jack adjustment

Five Thousand Men Work on International Road

Mexico's determination to hasten consummation of its long reach of the International Pacific Highway is manifest from the fact that the republic now has 5,000 men working thereon, reports the Automobile Club of Southern California. The great motor route links Fairbanks, Alaska, and Buenos Aires, Argentina.

Recent contracts awarded and on which construction is already progressing include, Tequila to Ixtlan, 51 miles; Ixtlan to Tuxpan, 116 miles; Tuxpan to Mazatlan, 155 miles; Mazatlan to Culiacan, 150 miles. These contracts call for grading, drainage structure installation, and surfacing with oil mix, a total stretch of 180 miles, including the Barrancas. The work must be accomplished in two years.

Completion of the contracts means development of 1,197 miles of the highway between Nogales and Mexico City.

California Rights of Way Legal Procedure Cited as Exemplary

IN an address before the Association of Highway Officials of the North Atlantic States, L. E. Boykin, Chief of the Division of Highway Laws and Contracts of the U. S. Public Roads Administration on laws and procedure permitting immediate entry and possession of property required for rights of way use by State highway departments, Mr. Boykin made the following favorable comment on the methods and organization of the Division of Contracts and Rights of Way of the California Department of Public Works:

"It occurred to me that it would be helpful to bring to your attention a brief outline of the organizational set-up and of the legal authority and procedure in a few States to illustrate how they operate. In this connection, I have selected California as one State which should be of interest, for two reasons; first, because of its organizational set-up, and second, because its laws are such that it can and does obtain rights of way expeditiously.

"The Division of Highways of California is a part of the Department of Public Works of the State. It created a right-of-way office in 1926. Prior thereto right-of-way matters in most instances were handled by the counties in which improvements were to be undertaken.

STATE LEGAL SET-UP

"The organization set-up at that time has since increased in personnel and importance and is now administered as a part of the Division of Contracts and Rights of Way. The chief of that division is also chief counsel for the Division of Highways and, with a staff of attorneys functioning under him, handles all legal matters, including condemnation cases when they reach the courts.

"For the field work there are two supervising right-of-way agents, one for northern California and one for southern California. There are at present 11 district right-of-way agents, 30 right-of-way agents, 11 right-of-way engineers, 1 architectural engineer, and necessary subordinate and clerical employes, all attached to the 11 engineering districts into which the State is divided and subject to the general supervision of the district engineer in charge of each district. However, they function strictly as a right-of-way organization.

OUTSIDE APPRAISERS EMPLOYED

"Under the procedure followed in California the property owner usually meets only one representative of the State during right-of-way negotiations. This contact is made by the right-of-way agent. Prior to contacting the owner, however, an appraisal of the value of the property to be acquired is made by the right-of-way agent.

"When it is necessary to resort to condemnation, outside appraisers are employed and are used as expert witnesses when the case comes to trial. The engineer of surveys and plans always takes into consideration the matter of right-of-way costs and when such costs on proposed alternate alignments are ready for discussion the right-of-way agents are invited to participate.

"If negotiations fail to reach an agreement with the property owner the matter is presented to the California Highway Commission with request that it adopt a resolution authorizing condemnation of the property. Such resolution is required by the statute (Streets and Highways Code, SS 102, 103), which recites that it shall be conclusive evidence:

"1. Of the public necessity of the proposed public improvement;

"2. That such real property or interest therein is necessary therefor; and

"3. That such proposed public improvement is planned or located in a manner which will be most compatible with the greatest public good and the least private injury.

COURTS GIVE PREFERENCE

"Upon the passage of such resolution the necessary legal papers for the filing of suit are prepared. The statute (Code of Civil Procedure, § 1243) requires that such suit shall be instituted in the Superior Court of the county in which the property sought to be taken is situated, unless such property should be situated in more than one county, in which event suit may be filed in either county and the county so selected shall be the proper county.

"The law provides (Code of Civil Procedure, § 1264) that all such proceedings shall be given preference by the courts over all other civil actions therein in the matter of setting the date for trial and in hearing the same, in order that all such actions shall be quickly heard and determined.

"A few days prior to the date set for trial the attorneys from the headquarters office of the division come to the district and hold pre-trial conferences with the district right-of-way personnel and witnesses, in final preparation for presentation of the case in court. In the meantime, however, the right-of-way agent continues his efforts to arrive at a settlement with the landowner, and in most cases an agreement is reached prior to the time set for trial.

"The State is authorized to take immediate possession and use of property upon commencing proceedings in court and giving such security in money deposited as the court may direct. It is the practice of the State to take possession immediately after filing the complaint in condemnation."

"Highway Mail Coach"

Uncle Sam's first "highway mail coach" is a success. This new service, which marks one of the most significant developments in mail transportation, has been operating for a month over a 140 mile route between Washington, D. C. and Harrisonburg, Virginia. Now two more trial routes are to be established.

Operated on the same basis as the railway mail service, the mails are carried on large bus-type trucks completely equipped with all facilities for sorting, handling and dispatch that are included in railway postal cars.

Gasoline Tax Apportionments to Ci

(Continued from page 1)

District I

CITY	STREETS OF MAJOR IMPORTANCE Section 194 Fiscal Year Ending June 30, 1940	STREETS OF MAJOR IMPORTANCE Section 194 Fiscal Year Ending June 30, 1941	STATE HIGHWAYS Section 203 Biennium Ending June 30, 1941
Del Norte County:			
Crescent City	$1,660.37	$1,174.07	$2,834.44
Humboldt County:			
Arcata	$1,649.75	$1,597.88	$3,247.63
Blue Lake	535.76	433.28	969.04
Eureka	15,205.96	14,690.94	29,896.90
Ferndale	858.19	776.10	1,634.29
Fortuna	1,196.04	1,217.14	2,413.18
Trinidad	103.29	80.97	184.26
Totals	$19,548.99	$18,796.31	$38,345.30
Lake County:			
Lakeport	$1,272.33	$1,283.47	$2,555.80
Mendocino County:			
Fort Bragg	$2,917.24	$2,786.58	$5,703.82
Point Arena	371.65	322.17	693.82
Ukiah	3,015.71	3,213.83	6,229.54
Willits	1,374.64	1,399.75	2,774.39
Totals	$7,679.24	$7,722.33	$15,401.57
Totals District I	$30,160.93	$28,976.18	$59,137.11

District II

CITY	Fiscal Year Ending June 30, 1940	Fiscal Year Ending June 30, 1941	Biennium Ending June 30, 1941
Lassen County:			
Susanville	$1,310.94	$1,356.68	$2,667.62
Modoc County:			
Alturas	$2,256.96	$1,800.30	$4,057.26
Plumas County:			
None			
Shasta County:			
Redding	$4,042.83	$6,984.98	$11,027.81
Siskiyou County:			
Dorris	$735.58	$743.37	$1,478.95
Dunsmuir	2,519.53	2,032.02	4,551.55
Etna	365.88	392.79	758.67
Fort Jones	291.53	310.10	601.63
Montague	489.42	398.82	888.24
Mount Shasta	1,026.14	1,393.73	2,419.87
Tulelake	289.60	676.19	965.79
Yreka City	2,124.70	2,140.54	4,265.24
Totals	$7,842.38	$8,087.56	$15,929.94
Tehama County:			
Corning	$1,329.26	$1,267.97	$2,597.23
Red Bluff	3,395.08	3,293.93	6,689.01
Tehama	183.41	150.74	334.15
Totals	$4,907.75	$4,712.64	$9,620.39
Totals District II	$20,360.86	$22,942.16	$43,303.02

District III

CITY	STREETS OF MAJOR IMPORTANCE Section 194 Fiscal Year Ending June 30, 1940	STREETS OF MAJOR IMPORTANCE Section 194 Fiscal Year Ending June 30, 1941	STATE HIGHWAYS Section 203 Biennium Ending June 30, 1941
Butte County:			
Biggs	$446.95	$471.17	$918.12
Chico	7,685.04	7,999.70	15,684.74
Gridley	1,873.71	2,013.93	3,887.64
Oroville	4,346.90	3,808.19	8,155.09
Totals	$14,352.60	$14,292.99	$28,645.59
Colusa County:			
Colusa	$2,042.66	$1,968.28	$4,010.94
Williams	838.86	701.16	1,540.02
Totals	$2,881.52	$2,669.44	$5,550.96
El Dorado County:			
Placerville	$2,284.95	$2,639.28	$4,924.23
Glenn County:			
Orland	$1,153.58	$1,176.66	$2,330.24
Willows	1,953.84	1,907.97	3,861.81
Totals	$3,107.42	$3,084.63	$6,192.05
Nevada County:			
Grass Valley	$3,684.67	$4,910.76	$8,595.43
Nevada City	1,642.04	2,106.09	3,748.13
Totals	$5,326.71	$7,016.85	$12,343.56
Placer County:			
Auburn	$2,568.76	$3,456.75	$6,025.51
Colfax	880.38	683.93	1,564.31
Lincoln	2,021.40	1,760.68	3,782.08
Rocklin	698.91	684.80	1,383.71
Roseville	6,202.28	5,803.07	12,005.35
Totals	$12,371.73	$12,389.23	$24,760.96
Sacramento County:			
North Sacramento	$2,560.07	$2,629.81	$5,189.88
Sacramento	90,500.15	91,270.76	181,770.91
Totals	$93,060.22	$93,900.57	$186,960.79
Sierra County:			
Loyalton	$807.99	$796.79	$1,604.78
Sutter County:			
Yuba City	$3,480.04	$4,279.37	$7,759.41
Yolo County:			
Davis	$1,199.91	$1,440.24	$2,640.15
Winters	864.94	975.95	1,840.89
Woodland	5,384.64	5,717.03	11,101.67
Totals	$7,449.49	$8,133.22	$15,582.71
Yuba County:			
Marysville	$5,563.22	$5,724.77	$11,287.99
Wheatland	462.40	427.24	889.64
Totals	$6,025.62	$6,152.01	$12,177.63
Totals District III	$151,148.29	$155,354.38	$306,502.67

District IV

CITY	Fiscal Year Ending June 30, 1940	Fiscal Year Ending June 30, 1941	Biennium Ending June 30, 1941
Alameda County:			
Alameda	$33,818.58	$31,230.43	$65,049.01
Albany	8,271.96	9,899.91	18,171.87
Berkeley	79,262.70	73,689.02	152,951.72
Emeryville	2,255.02	2,171.56	4,426.58
Hayward	5,338.31	5,802.29	11,140.60
Livermore	3,010.87	2,485.10	5,495.97
Oakland	274,215.96	260,279.06	534,495.02
Piedmont	9,009.47	8,498.43	17,507.90
Pleasanton	1,194.11	1,100.85	2,294.96
San Leandro	11,075.77	12,577.11	23,652.88
Totals	$427,452.75	$407,733.76	$835,186.51

for Biennium Ending June 30, 1941

CITY	STREETS OF MAJOR IMPORTANCE Section 194 Fiscal Year Ending June 30, 1940	Fiscal Year Ending June 30, 1941	STATE HIGHWAYS Section 203 Biennium Ending June 30, 1941
Contra Costa County:			
Antioch	$5,003.33	$4,519.75	$9,523.08
Concord	1,086.00	1,275.71	2,361.71
El Cerrito	3,735.85	5,286.32	9,022.17
Hercules	378.41	295.46	673.87
Martinez	7,656.06	6,357.90	14,013.96
Pinole	753.92	804.53	1,558.45
Pittsburg	9,276.87	8,200.39	17,477.26
Richmond	19,913.42	20,364.91	40,278.33
Walnut Creek	978.86	1,359.26	2,338.12
Totals	$48,782.72	$48,464.23	$97,246.95
Marin County:			
Belvedere	$482.67	$393.65	$876.32
Corte Madera	991.40	945.80	1,937.20
Fairfax	2,823.61	1,893.32	4,716.93
Larkspur	1,197.98	1,342.04	2,540.02
Mill Valley	4,019.65	4,175.13	8,194.78
Ross	1,308.03	1,508.29	2,816.32
San Anselmo	4,488.81	4,987.43	9,476.24
San Rafael	7,743.91	7,384.66	15,128.57
Sausalito	3,539.88	3,049.32	6,589.20
Totals	$26,595.94	$25,679.64	$52,275.58
apa County:			
Calistoga	$965.33	$968.20	$1,933.53
Napa	6,213.86	6,667.14	12,881.00
St. Helena	1,527.17	1,514.32	3,041.49
Totals	$8,706.36	$9,149.66	$17,856.02
an Francisco County:			
San Francisco	$612,402.72	$546,580.60	$1,158,983.32
an Mateo County:			
Atherton	$1,278.10	$1,643.53	$2,921.63
Bayshore	845.47	0.00	845.47
Belmont	964.37	1,058.64	2,023.01
Burlingame	12,809.99	13,730.49	26,540.48
Daly City	8,142.60	8,290.85	16,433.45
Hillsborough	1,839.94	2,366.23	4,206.17
Lawndale	356.22	304.93	661.15
Menlo Park	2,175.86	2,806.40	4,982.26
Redwood City	8,651.34	10,726.84	19,378.18
San Bruno	3,484.87	5,615.37	9,100.24
San Carlos	1,092.76	3,032.08	4,124.84
San Mateo	12,989.54	16,713.49	29,703.03
South San Francisco	5,978.31	5,710.13	11,688.44
Totals	$60,609.37	$71,998.98	$132,608.35
anta Clara County:			
Alviso	$367.79	$583.16	$950.95
Gilroy	3,380.61	3,113.90	6,494.51
Los Gatos	3,058.18	3,098.40	6,156.58
Morgan Hill	876.53	873.44	1,749.97
Mountain View	3,193.33	3,399.03	6,592.36
Palo Alto	13,401.74	14,448.89	27,850.63
San Jose	60,454.82	58,967.93	119,422.75
Santa Clara	6,083.54	5,728.23	11,811.77
Sunnyvale	2,986.74	3,766.85	6,753.59
Totals	$93,803.28	$93,979.83	$187,783.11
nta Cruz County:			
Santa Cruz	$13,895.99	$14,553.98	$28,449.97
Watsonville	8,341.47	8,173.82	16,515.29
Totals	$22,237.46	$22,727.80	$44,965.26

CITY	STREETS OF MAJOR IMPORTANCE Section 194 Fiscal Year Ending June 30, 1940	Fiscal Year Ending June 30, 1941	STATE HIGHWAYS Section 203 Biennium Ending June 30, 1941
Sonoma County:			
Cloverdale	$732.69	$696.86	$1,429.55
Healdsburg	2,216.40	2,159.48	4,375.88
Petaluma	7,959.20	6,920.37	14,879.57
Santa Rosa	10,387.41	10,857.78	21,245.19
Sebastopol	1,700.93	1,598.74	3,299.67
Sonoma	946.03	997.49	1,943.52
Totals	$23,942.66	$23,230.72	$47,173.38
Totals District IV	$1,324,533.26	$1,249,545.22	$2,574,078.48

District V

CITY	Fiscal Year Ending June 30, 1940	Fiscal Year Ending June 30, 1941	Biennium Ending June 30, 1941
Monterey County:			
Carmel-by-the-Sea	$2,181.67	$2,443.76	$4,625.43
King City	1,431.60	1,522.92	2,954.52
Monterey	8,824.12	8,686.22	17,510.34
Pacific Grove	5,365.32	5,382.81	10,748.13
Salinas	10,101.26	9,980.02	20,081.28
Soledad	573.41	741.65	1,315.06
Totals	$28,477.38	$28,757.38	$57,234.76
San Benito County:			
Hollister	$3,626.76	$3,343.04	$6,969.80
San Juan	745.25	584.02	1,329.27
Totals	$4,372.01	$3,927.06	$8,299.07
San Luis Obispo County:			
Arroyo Grande	$861.07	$938.92	$1,799.99
El Paso de Robles	2,483.81	2,622.92	5,106.73
Pismo Beach	1,156.72	0.00	1,156.72
San Luis Obispo	7,989.11	7,934.22	15,923.33
Totals	$12,490.71	$11,496.06	$23,986.77
Santa Barbara County:			
Lompoc	$2,746.38	$2,910.62	$5,657.00
Santa Barbara	32,447.80	30,112.34	62,560.14
Santa Maria	6,812.37	7,340.74	14,153.11
Totals	$42,006.55	$40,363.70	$82,370.25
Totals District V	$87,346.65	$84,544.20	$171,890.85

District VI

CITY	Fiscal Year Ending June 30, 1940	Fiscal Year Ending June 30, 1941	Biennium Ending June 30, 1941
Fresno County:			
Clovis	$1,270.38	$1,400.61	$2,670.99
Coalinga	2,752.17	4,329.33	7,081.50
Firebaugh	488.46	606.42	1,094.88
Fowler	1,130.41	1,318.78	2,449.19
Fresno	52,524.06	52,872.76	105,396.82
Kingsburg	1,276.17	1,295.52	2,571.69
Parlier	544.46	668.44	1,212.90
Reedley	2,499.25	2,730.59	5,229.84
Sanger	2,864.15	3,460.18	6,324.33
San Joaquin	157.34	206.74	364.08
Selma	2,941.38	3,158.70	6,100.08
Totals	$68,448.23	$72,048.07	$140,496.30
Kern County:			
Bakersfield	$25,113.19	$25,197.27	$50,310.46
Delano	2,540.76	3,939.11	6,479.87
Maricopa	1,033.88	577.13	1,611.01
Shafter	1,252.95	1,083.63	2,336.58
Taft	3,322.68	2,760.75	6,083.43
Tehachapi	710.49	1,088.79	1,799.28
Totals	$33,973.95	$34,646.68	$68,620.63

Gasoline Tax Apportionments to Ci

CITY	STREETS OF MAJOR IMPORTANCE Section 194 Fiscal Year Ending June 30, 1940	STREETS OF MAJOR IMPORTANCE Section 194 Fiscal Year Ending June 30, 1941	STATE HIGHWAYS Section 203 Biennium Ending June 30, 1941
Kings County:			
Corcoran	$1,706.72	$1,802.02	$3,508.74
Hanford	6,784.37	7,092.65	13,877.02
Lemoore	1,350.51	1,473.84	2,824.35
Totals	$9,841.60	$10,368.51	$20,210.11
Madera County:			
Chowchilla	$817.63	$1,685.74	$2,503.37
Madera	4,503.29	5,561.96	10,065.25
Totals	$5,320.92	$7,247.70	$12,568.62
Tulare County:			
Dinuba	$2,865.11	$3,264.65	$6,129.76
Exeter	2,701.34	3,344.77	6,046.11
Lindsay	3,743.57	3,787.51	7,531.08
Porterville	5,119.17	5,400.89	10,520.06
Tulare	6,000.53	7,114.20	13,114.73
Visalia	7,011.23	7,669.78	14,681.01
Woodlake	520.36	987.15	1,507.51
Totals	$27,961.31	$31,568.95	$59,530.26
Totals District VI	$145,546.01	$155,879.91	$301,425.92

District VII

CITY	Fiscal Year Ending June 30, 1940	Fiscal Year Ending June 30, 1941	Biennium Ending June 30, 1941
Los Angeles County:			
Alhambra	$28,450.35	$33,538.08	$61,988.43
Arcadia	5,035.19	7,857.57	12,892.76
Avalon	1,831.24	1,410.09	3,241.33
Azusa	4,641.33	4,486.96	9,128.29
Bell	7,610.70	9,702.65	17,313.35
Beverly Hills	16,824.83	23,104.97	39,929.80
Burbank	16,084.40	29,577.42	45,661.82
Claremont	2,624.74	2,633.26	5,258.00
Compton	12,082.13	13,952.74	26,034.87
Covina	2,689.43	2,626.37	5,315.80
Culver City	5,472.49	7,731.79	13,204.28
El Monte	3,358.41	4,088.13	7,446.54
El Segundo	3,381.58	3,219.86	6,601.44
Gardena	6,799.83	5,089.93	11,889.76
Glendale	60,561.26	71,135.01	131,696.27
Glendora	2,665.29	2,430.83	5,096.12
Hawthorne	6,367.34	7,117.64	13,484.98
Hermosa Beach	4,629.74	6,199.40	10,829.14
Huntington Park	23,738.56	24,676.99	48,415.55
Inglewood	20,678.44	25,939.78	46,618.22
La Verne	2,760.86	2,663.40	5,424.26
Long Beach	137,936.71	141,524.03	279,460.74
Los Angeles	1,197,570.46	1,295,763.58	2,493,334.04
Lynwood	7,069.15	9,459.75	16,528.90
Manhattan Beach	1,825.44	5,511.15	7,336.59
Maywood	8,133.91	9,243.54	17,377.45
Monrovia	10,512.50	11,031.78	21,544.28
Montebello	5,307.40	6,904.87	12,212.27
Monterey Park	6,183.93	7,348.49	13,532.42
Palos Verdes Estates	684.16	850.20	1,534.36
Pasadena	73,714.92	70,516.52	144,231.44
Pomona	20,082.82	20,276.17	40,358.99
Redondo Beach	$9,022.99	$11,277.28	$20,300.27
San Fernando	7,304.68	7,833.44	15,138.12
San Gabriel	7,045.98	10,222.08	17,268.06
San Marino	3,600.70	7,041.83	10,642.53
Santa Monica	35,858.33	46,084.16	81,942.49
Sierra Madre	3,426.94	3,946.01	7,372.95
Signal Hill	2,830.36	2,742.65	5,573.01
South Gate	18,951.45	23,210.05	42,161.50
South Pasadena	13,254.05	12,366.07	25,620.12
Los Angeles County—Continued:			
Torrance	8,527.77	8,570.79	17,098.56
Vernon	1,225.02	732.18	1,957.20
West Covina	962.44	923.40	1,885.84
Whittier	14,331.36	13,887.21	28,218.57
Totals	$1,833,651.61	$2,016,450.10	$3,850,101.71
Orange County:			
Anaheim	$10,631.23	$9,501.96	$20,133.19
Brea	2,350.60	2,211.19	4,561.79
Fullerton	10,483.53	8,994.59	19,478.12
Huntington Beach	3,562.09	3,219.86	6,781.95
Laguna Beach	1,912.33	3,841.78	5,754.11
La Habra	2,194.20	2,152.60	4,346.80
Newport Beach	2,126.63	3,822.83	5,949.46
Orange	7,786.39	6,805.82	14,592.21
Placentia	1,550.33	1,267.96	2,818.29
San Clemente	643.88	412.60	1,056.48
Santa Ana	29,270.89	27,496.31	56,767.20
Seal Beach	1,115.93	1,337.73	2,453.66
Tustin	893.91	820.90	1,714.81
Totals	$74,521.94	$71,886.13	$146,408.07
Ventura County:			
Fillmore	$2,792.72	$2,801.23	$5,593.95
Ojai	1,417.10	1,397.17	2,814.27
Oxnard	6,067.13	7,338.14	13,405.27
San Buenaventura	11,200.78	11,425.43	22,626.21
Santa Paula	7,193.68	7,740.42	14,934.10
Totals	$28,671.41	$30,702.39	$59,373.80
Totals District VII	$1,936,844.96	$2,119,038.62	$4,055,883.58

District VIII

CITY	Fiscal Year Ending June 30, 1940	Fiscal Year Ending June 30, 1941	Biennium Ending June 30, 1941
Riverside County:			
Banning	$2,671.08	$3,337.01	$6,008.09
Beaumont	1,285.82	1,901.94	3,187.76
Corona	6,774.72	7,549.19	14,323.91
Elsinore	1,303.20	1,336.86	2,640.06
Hemet	2,157.52	2,235.30	4,392.82
Palm Springs	2,464.51	2,958.01	5,422.52
Perris	736.56	870.86	1,607.42
Riverside	28,666.58	29,886.66	58,553.24
San Jacinto	1,299.34	1,168.04	2,467.38
Totals	$47,359.33	$51,243.87	$98,603.20
San Bernardino County:			
Chino	$3,009.92	$3,621.26	$6,631.18
Colton	7,744.88	8,835.73	16,580.61
Needles	3,035.00	3,121.67	6,156.67
Ontario	13,112.15	12,260.64	25,372.79
Redlands	13,685.56	12,338.50	26,024.06
Rialto	1,585.09	1,524.65	3,109.74
San Bernardino	37,713.70	37,606.40	75,320.10
Upland	4,549.62	5,440.51	9,990.13
Totals	$84,435.92	$84,749.36	$169,185.28
Totals District VIII	$131,795.25	$135,993.23	$267,788.48

District IX

CITY	Fiscal Year Ending June 30, 1940	Fiscal Year Ending June 30, 1941	Biennium Ending June 30, 1941
Inyo County:			
Bishop	$1,118.82	$1,283.47	$2,402.29

for Biennium Ending June 30, 1941

CITY	STREETS OF MAJOR IMPORTANCE Section 194 Fiscal Year Ending June 30, 1940	Fiscal Year Ending June 30, 1941	STATE HIGHWAYS Section 203 Biennium Ending June 30, 1941
ono County:			
None			
tals District IX	$1,118.82	$1,283.47	$2,402.29

District X

CITY	STREETS OF MAJOR IMPORTANCE Section 194 Fiscal Year Ending June 30, 1940	Fiscal Year Ending June 30, 1941	STATE HIGHWAYS Section 203 Biennium Ending June 30, 1941
nador County:			
Amador	$165.08	$214.48	$379.56
Jackson	1,935.50	1,743.44	3,678.94
Plymouth	331.10	396.24	727.34
Sutter Creek	977.88	976.82	1,954.70
Totals	$3,409.56	$3,330.98	$6,740.54
laveras County:			
Angels	$883.28	$1,001.80	$1,885.08
ariposa County:			
Hornitos	$59.85	$136.96	$196.81
erced County:			
Atwater	$885.21	$1,063.81	$1,949.02
Dos Palos	897.77	842.43	1,740.20
Gustine	980.77	1,167.18	2,147.95
Livingston	775.16	770.95	1,546.11
Los Banos	1,810.01	1,907.10	3,717.11
Merced	6,821.06	8,730.15	15,551.21
Totals	$12,169.98	$14,481.62	$26,651.60
cramento County:			
sleton	$2,805.27	$1,582.36	$4,387.63
n Joaquin County:			
Lodi	$7,170.39	$9,543.30	$16,713.69
Manteca	1,558.06	1,706.40	3,264.46
Stockton	46,300.35	47,129.89	93,430.24
Tracy	3,696.27	3,493.79	7,190.06
Totals	$58,725.07	$61,873.38	$120,598.45
lano County:			
Benicia	$2,812.01	$2,083.69	$4,895.70
Dixon	965.33	954.42	1,919.75
Fairfield	1,091.79	1,130.14	2,221.93
Rio Vista	1,263.61	1,435.06	2,698.67
Suisun City	873.64	608.14	1,481.78

CITY	STREETS OF MAJOR IMPORTANCE Section 194 Fiscal Year Ending June 30, 1940	Fiscal Year Ending June 30, 1941	STATE HIGHWAYS Section 203 Biennium Ending June 30, 1941
Solano County—Continued:			
Vacaville	1,803.25	1,390.28	3,193.53
Vallejo	14,747.43	17,289.75	32,037.18
Totals	$23,557.06	$24,891.48	$48,448.54
Stanislaus County:			
Ceres	$946.99	$1,147.37	$2,094.36
Modesto	13,606.89	14,437.32	28,044.21
Newman	1,225.02	1,045.72	2,270.74
Oakdale	2,038.77	2,232.72	4,271.49
Patterson	873.64	955.28	1,828.92
Riverbank	775.17	973.36	1,748.53
Turlock	4,127.77	4,168.24	8,296.01
Totals	$23,594.25	$24,960.01	$48,554.26
Tuolumne County:			
Sonora	$2,199.04	$1,944.15	$4,143.19
Totals District X	$127,403.36	$134,202.74	$261,606.10

District XI

CITY	STREETS OF MAJOR IMPORTANCE Section 194 Fiscal Year Ending June 30, 1940	Fiscal Year Ending June 30, 1941	STATE HIGHWAYS Section 203 Biennium Ending June 30, 1941
Imperial County:			
Brawley	$10,077.14	$10,093.73	$20,170.87
Calexico	6,080.65	4,664.40	10,745.05
Calipatria	1,500.13	1,549.63	3,049.76
El Centro	8,141.64	8,628.51	16,770.15
Holtville	1,697.06	1,526.38	3,223.44
Imperial	1,875.64	1,286.05	3,161.69
Westmorland	1,424.83	870.00	2,294.83
Totals	$30,797.09	$28,618.70	$59,415.79
Riverside County:			
Blythe	$984.65	$2,028.56	$3,013.21
Indio	2,510.83	1,977.74	4,488.57
Totals	$3,495.48	$4,006.30	$7,501.78
San Diego County:			
Chula Vista	$3,734.88	$4,425.81	$8,160.69
Coronado	5,236.94	5,971.12	11,208.06
El Cajon	1,013.61	1,267.10	2,280.71
Escondido	3,302.41	3,927.92	7,230.33
La Mesa	2,425.89	3,380.95	5,806.84
National City	7,047.91	8,910.18	15,958.09
Oceanside	3,392.18	4,006.31	7,398.49
San Diego	146,435.52	175,155.14	321,590.66
Totals	$172,589.34	$207,044.53	$379,633.87
Totals District XI	$206,881.91	$239,669.53	$446,551.44

lotor Transportation Is Big Business

U. S. motor transportation is the ation's biggest business, with an nnual investment equal to one-tenth the National income, with more an 6,000,000 employees and with irty million American stockholders, ccording to Charles M. Upham, gineer-director, American Road uilders Association.

"Useful and productive employ-ent for both labor and capital in this industry is founded on the public highway facilities of the Nation," Mr. Upham writes. Add to this the social and cultural benefits of good roads and it becomes apparent that every citizen has an important stake in the National highway system.

"If you buy stock in an ordinary corporation, to which you pay $50 every year, you want to know a great deal about that corporation. You are entitled to an annual report setting forth facts about assets, management, dividends and so forth. Yet the average motor-vehicle owner, who invests $50 a year in highway taxes is supplied with few facts about the highway system. The highway system is the most important factor in the Nation's economic system, but the extent of its influence on agriculture, industry, commerce and general welfare has never been completely evaluated. Since roads affect the lives and welfare of every individual, the development of the highway-transportation system should be based on a thorough knowledge of its effect on the Nation.

Views of two sections of Cahuenga Pass Freeway in Los Angeles County that was reconstructed into a 12-lane divided highway largely with gas tax funds totaling $886,000. Additional funds were contributed by PWA, Los Angeles City and County

President Pays Honor to State Highway Chief

APPOINTMENT of State Highway Engineer Charles H. Purcell as a member of a special seven-man committee to make a study during the coming summer of post-war developments of an improved system of National highways, has been announced by President Roosevelt.

The committee will serve in an advisory capacity to John M. Carmody, Federal Works Administrator.

Others appointed to the committee are Thomas H. MacDonald, U. S. Public Roads Commissioner; G. Donald Kennedy, Michigan Highway Commissioner; Bibb Graves, former Governor of Alabama; Frederick A. Delano, Chairman of the National Resources Planning Board; Harland Bartholomew, City Planner of St. Louis; and Rexford G. Tugwell, Chairman of the New York City Planning Commission.

In a letter to Mr. Purcell asking him to serve, President Roosevelt said:

"I am asking you to serve as a member of an Interregional Highway Committee, which is to act in an advisory capacity to the Federal Works Administrator. The committee is to review existing data and surveys for the purpose of recommending and outlining a limited system of National highways designed to provide a basis for improved interregional transportation.

"I should like to have the committee make an early study so that as a result of their recommendations we can shortly undertake the preparation of detailed plans and specifications. This will permit us, upon the completion of our defense program, to utilize productively some of the man power and industrial capacity then available to construct a National system of interregional highways."

In announcing the appointment of the committee, the President said:

"Most of the members of this committee have both an extensive knowledge of the problem and sympathetic interest in its solution. It is my hope that our National needs will be paramount in their deliberations."

April Traffic Totals 1,836,012 Vehicles on State Toll Bridges

THE month of April witnessed a continuation of the large volume of traffic which has for some time been a notable characteristic of the State-owned toll bridges. The daily average for the San Francisco-Oakland Bay Bridge for the month was 49,716. The highest single day's total occurred on Easter Sunday, when 71,745 vehicles crossed the bridge. This record has been exceeded on only two other days since the opening of the bridge.

On the Carquinez Bridge, a new high record was established with an average of 10,821 vehicles per day.

The traffic over the Antioch Bridge, although much less in volume than over the other two bridges, showed a substantial increase over the record of April, 1940.

The total traffic for April on the San Francisco-Oakland Bay Bridge and the Carquinez and Antioch bridges is tabulated below:

	San Francisco-Oakland Bay Bridge	Carquinez Bridge	Antioch Bridge
Passenger autos and auto trailers	1,356,242	295,536	16,390
Motorcycles and tricars	3,610	914	30
Buses	29,292	4,904	195
Trucks and truck trailers	75,903	23,020	3,147
Others	26,430	262	137
Total vehicles	1,491,477	324,636	19,899

Transfers Move Traffic and Safety Engineers

The National Defense Program has made necessary a number of transfers among the personnel of the Department of Traffic and Safety of the Division of Highways.

District Traffic Engineer Harry L. Webb, District X, Stockton, was called to active duty in the Army and is now a major on the staff of the 184th Infantry at Camp San Luis Obispo. When Mr. Webb left District X, George Greenwood was made Acting District Traffic Engineer. However, he was in the Naval Reserve and this month was ordered to active duty as First Lieutenant Engineer Corps at Cavite, Philippine Islands. He sailed for Manila on May 8th.

Richard Wilson, Associate Traffic Engineer, long employed by District IV, San Francisco, has been transferred to Stockton to succeed Greenwood.

W. R. Cobb, Associate Traffic Engineer in Central Headquarters, Sacramento, who has been with the Division of Highways since December 1, 1933, has been transferred from Central Office to District IV to replace Wilson.

W. L. Welch, who entered State service with the Division of Highways September 16, 1929, has been transferred from the Central Office to the Traffic Department of District VII in Los Angeles.

Carmody Recommends $287,000,000 for Highways

(Continued from page 5)

roads conforming to the main lines of the strategic network, as designated by the War and Navy Departments; (2) make roads and bridges on auxiliary lines of the network eligible for improvement with Federal Aid secondary road funds; and (3) permit the use of Federal Aid funds in payment of part of the cost of acquiring necessary rights of way and attendant property damage.

The problem of reservation roads, including company streets in Army cantonments and naval establishments, totaling about 1,500 miles, is not included in the recommendations for expenditures because provision is currently being made for them by the Army and Navy.

Traffic Hazards Eliminated in Red Rock Canyon

(Continued from page 6)

Between Mojave and Ricardo the highway traverses a section of desert typical of southeastern California. The land, in general, rises and falls over the debris cones that have been brought down from the bordering mountains by the numerous cloudbursts which are typical of the region. These washes, intersecting the highway, are usually dry but at times, for short periods, may carry a flash flood that is beyond the capacity of any reasonably-sized bridge or culvert structure to carry.

DIPS SOLVED PROBLEM

The original construction of the highway through this vicinity solved a problem by the construction of numerous dips in the grade line at points where flooding could be expected. This treatment proved adequate for the volume and speed of traffic using the highway for a number of years subsequent to its construction. However, the accident hazard gradually increased with greater speeds and volume and during the past two years it became apparent that further betterment of conditions must be undertaken if the accident ratio on this section of highway was to be held within reasonable bounds.

Studies of the behavior of water and debris carried in the washes, conducted over a period of years, indicated the inecomomy and impracticability of building bridges of large enough capacity to handle all floods. While the average run-off could be easily handled in this manner, there are occasional floods of great volume—floods that would require very costly bridges over the water to be conducted. Such bridges, it must be realized, would present an absurd appearance, and would serve a need only during periods seldom exceeding an hour, and at intervals of probably several years.

COMPROMISE PLAN RESULTED

In order to secure the utmost of service and safety to the traveling public, a compromise plan was adopted which involved the handling of the usual water run-off by means of large diameter pipes or culverts, with a highway grade line so laid as to provide dips for periods of peak floods.

The existence of short, depressed sections on a primary highway, traversing open desert country, constitutes a potential hazard and obstructs the uniform, free flow of traffic. This hazard is greatly increased when depressions become partially filled with silt, rocks, and sand by excessive floods, particularly when these obstructions are so located that approaching high-speed traffic encounters them without adequate warning.

Under normal conditions the riding qualities of the highway are materially impaired by the existence of these short, vertical curves. Likewise, the restricted sight distance at an average dip may be a direct or indirect cause of traffic friction.

SPEED DESIGNS ADOPTED

In order to overcome these undesirable conditions, the improvement was planned by taking into consideration all factual data accumulated through a carefully planned traffic and safety study. Preliminary traffic speed checks were taken for the purpose of determining tentative design classification, as well as studies to indicate the critical speeds encountered by present-day traffic.

The designed speed finally adopted as a result of these studies varied from 50 miles per hour in the winding Red Rock Canyon section to 70 miles per hour in the desert section.

Modifications in standard practices were also required in order to ensure that objects such as boulders or loose sand which possibly might be carried upon the roadway by floods would be sufficiently illuminated by car headlights as to give ample opportunity for the operator of a vehicle to come to a safe stop before striking an obstacle.

These studies have resulted in a design that permits high-speed traffic to traverse the dip with confidence and with a reasonable exercise of care on the part of the operator, with absolute safety.

Maintenance Men Invent "Mercy Sled"

NECESSITY was the mother of an invention conceived by the Maintenance Department of District V of the State Division of Highways to expeditiously care for injured motorists in the mountainous areas of the district, which embraces Monterey, San Benito, San Luis Obispo and Santa Barbara counties.

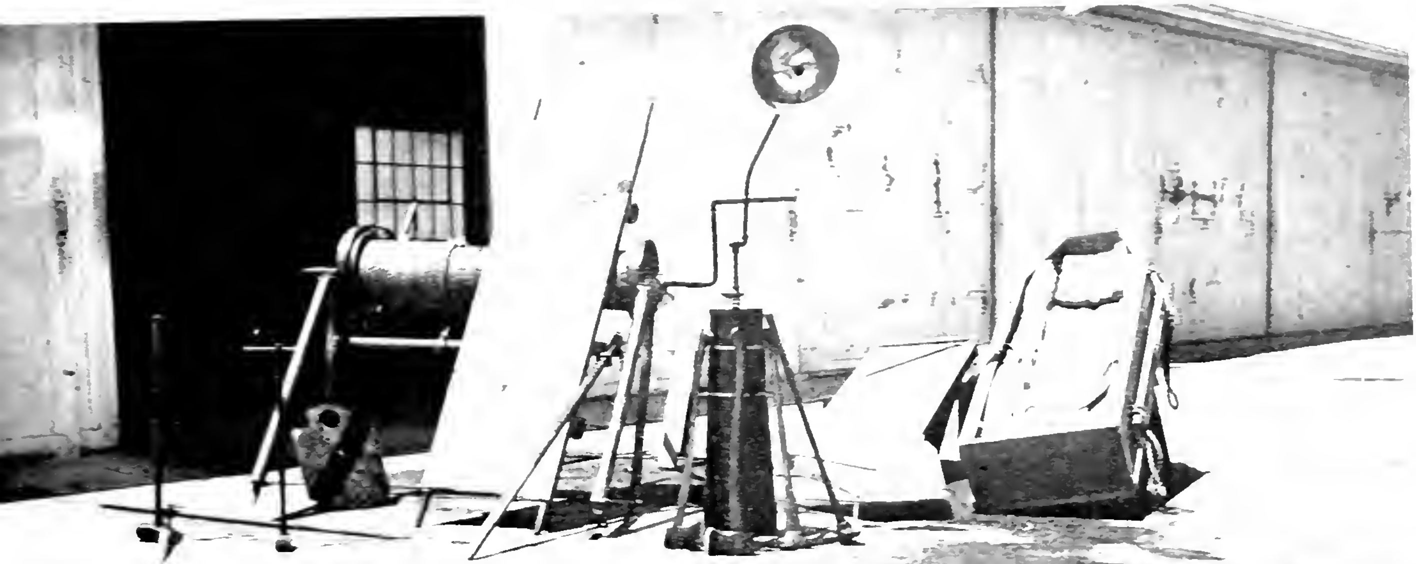
Recently an automobile plunged off the highway in Monterey County near Willow Camp and rolled down a 500-foot embankment. Of the five persons in the car, four were so seriously injured that they had to be carried to the highway on stretchers. Members of the maintenance crew at Willow Camp labored for four hours carrying the victims up the steep slope of the canyon into which the automobile had dropped.

FILLED AN EMERGENCY

As a result of this experience, they constructed a device which they call a "mercy sled." The sled is a wooden box with a camp bed mattress placed in it. A rope tied to the box runs through a tackle block, which is set up on the roadway at the point where the sled is to be lowered over an embankment or cliff.

The maintenance crew had occasion to use this sled shortly after it was built. An automobile driven by a woman skidded off the highway and fell a distance of some 100 feet. The maintenance crew rushed the sled to the scene of the accident and lowered it to the victim, who had been given first aid by a physician hastily summoned.

The injured woman was placed in the sled and carefully strapped in place to prevent any jarring of her broken body. The end of the rope attached to the sled was tied to the rear axle of a truck which slowly pulled the box up to the highway, where an ambulance awaited. Without the mercy sled it would have required an hour to remove the victim from the canyon instead of the few minutes that were necessary. The sled was built by Frank Odom at the request of District Engineer Gibson.



"Mercy Sled" equipment built by maintenance crew of District 8 shown at top includes hoisting apparatus, stretcher, portable searchlight and sled. Below, two views showing sturdy construction of sled. Man is Frank Doom of crew, the designer and builder.

Six-Lane Divided Freeway Planned Through Balboa Park, San Diego

By E. E. WALLACE, District Engineer

An estimated increase of over 30 per cent in population within the past few months in San Diego, due to defense activities, has resulted in heavy increase in traffic on all main highways within or entering the city.

The conditions which are developing were foreseen and early last Fall a system of "Access Highways" was designated at a conference which was held at the Headquarters of the Commandant of the Eleventh Naval District in San Diego, at which representatives of the Navy, Army, Marines, Public Roads Administration, and the State Division of Highways agreed on the more important highways which should be improved or rebuilt in order to provide necessary access to the various Federal activities.

One such access highway is U. S. No. 395 which is the inland highway connecting San Diego with the Marines' Camp Elliott and the large housing project on Kearny Mesa, thence through Escondido to March Field, Riverside, and the Metropolitan area of Los Angeles.

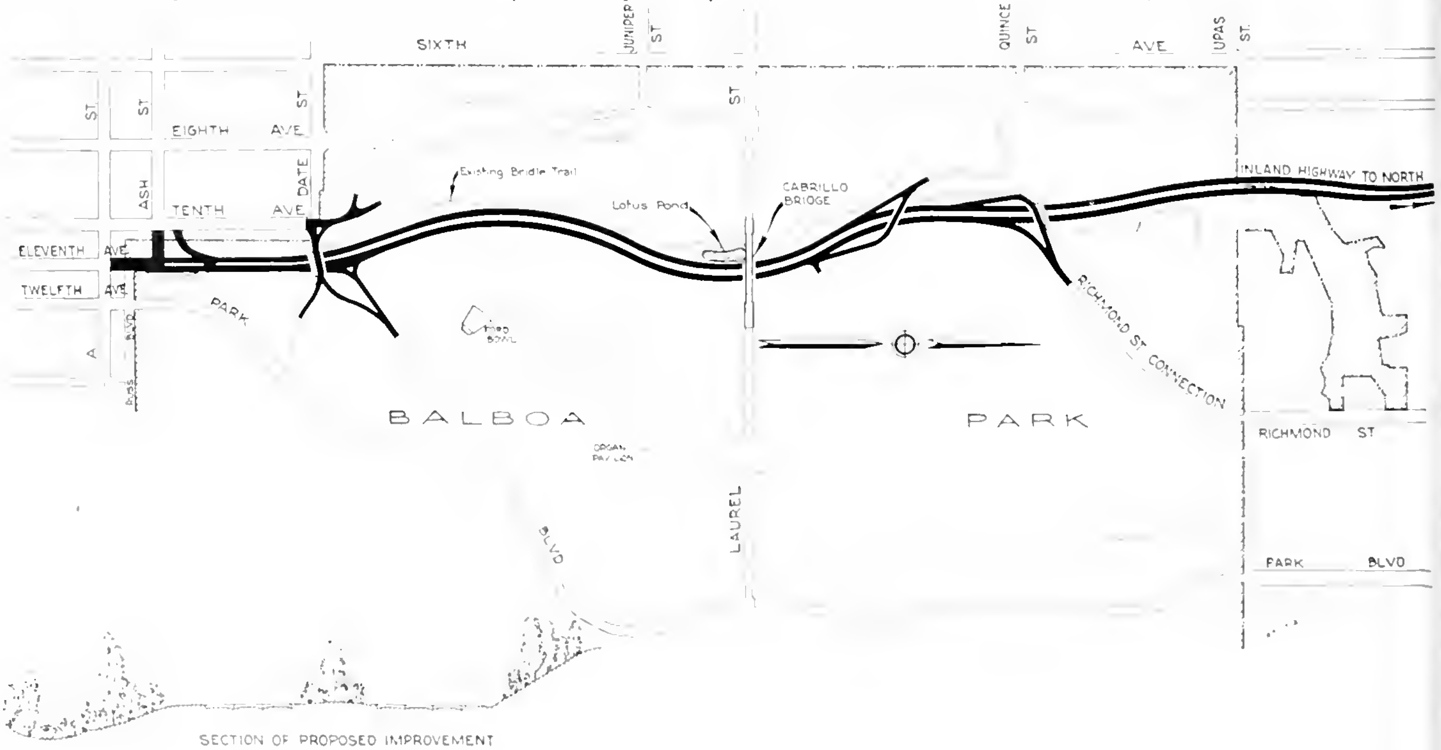
The present highway enters San Diego through a circuitous route passing to the east of the business center. A more direct connection with the various activities is desirable and a new routing was therefore adopted by the State Highway Commission, proposing a freeway or parkway development into the center of San Diego. This required a highway development through Balboa Park which is the pride of San Diego and in which both the 1915 and 1935 fairs were held.

The charter provision required a two-thirds majority vote of the people to set aside any portion of the park for other than park purposes, and on March 25, 1941, the people of San Diego, by a vote of eight to one, set aside a 200-foot width of right of way through Cabrillo Canyon to be developed as a parkway and to serve as a portion of the State highway entering San Diego from the north.

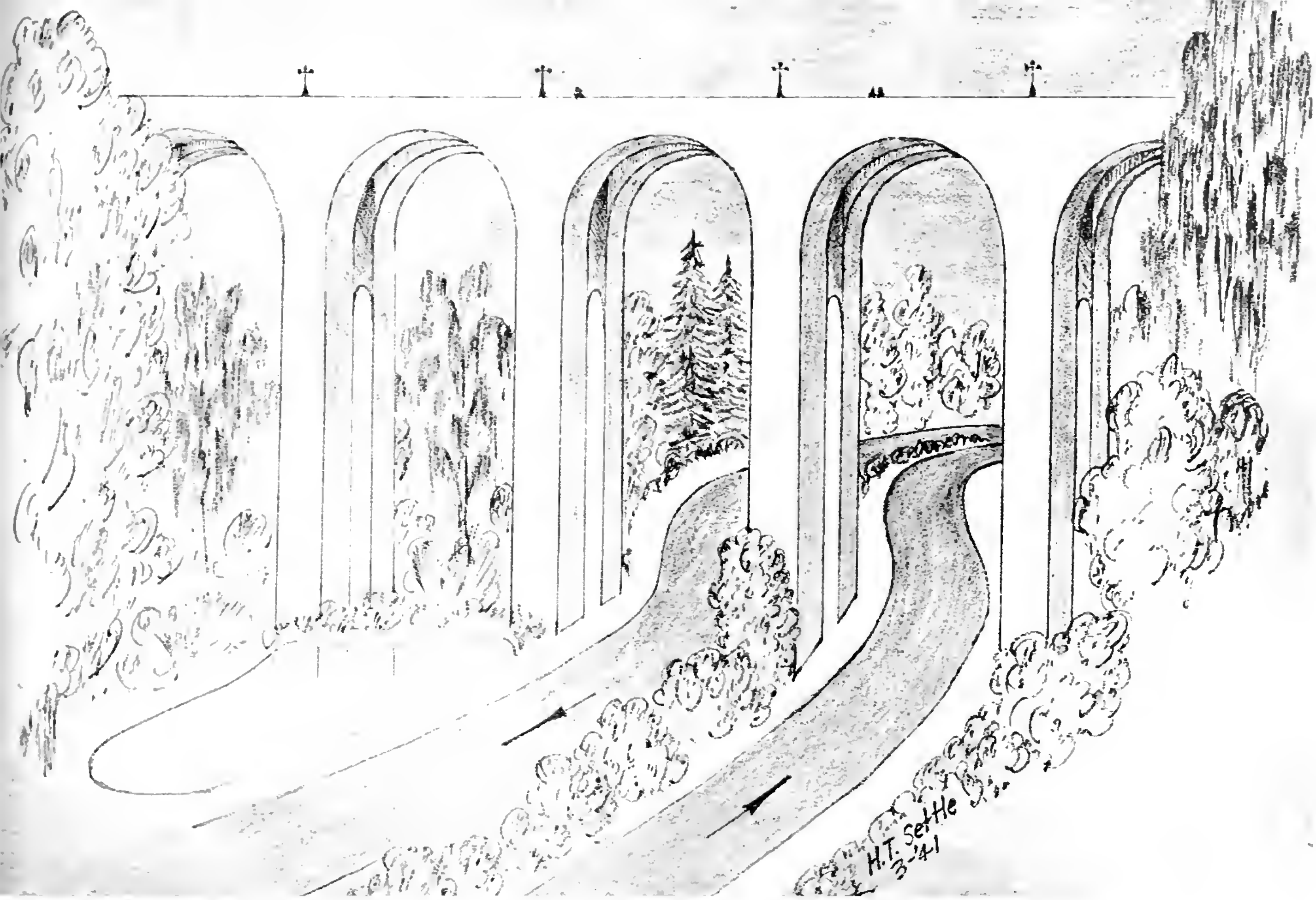
Surveys have already been completed by District XI Office and the first unit will be ready to advertise for contract as soon as access highway funds are made available by Congressional action.

The extent of the first improvement depends on the Federal appropriations which may become available but a substantial start is assured by allotments included in the next biennial State Highway Budget, together with ½c gas tax funds for expenditure on State Highway Routes within the city.

The plans now being prepared provide for a six-lane divided highway through Balboa Park and underneath University Avenue, thence under the Washington Street extension which will connect with El Cajon Avenue, then on a new location along the east side of the Sixth Street Canyon and across San Diego River on a modern concrete bridge.



SECTION OF PROPOSED IMPROVEMENT THROUGH CANYON



Sketch showing a proposed division of lanes of the new highway passing under Cabrillo Bridge in Balboa Park

The divided highway will extend cross Kearny Mesa and will be free rom highway intersections at grade rom the business district to the Mesa. Several structures will be utilized hrough the park to provide separaions of approaching highways so the raffic will enter the freeway on the roper side and without intersecting pposing lines of traffic.

When completed, the highway will e a freeway comparable with the rroyo Seco Freeway between Los ngeles and Pasadena.

The portion through the park will e landscaped to conform with the djacent park development and, when ompleted, the highway will provide n unexcelled parkway entrance into the heart of the city as well as a more direct and expeditious traffic route.

A few of the problems that develop in connection with the project involve:

Proper provision for drainage of storm waters that accumulate in the canyon.

Saving, where possible, attractive groups of trees and existing landscaping.

Providing for present and proposed water and sewer mains, bridle paths, walks and crossings.

Acquisition of rights of way and moving of buildings on the portion outside of the park.

Proper handling of traffic consisting of over 30,000 vehicles per day; street car traffic, existing public utilities, etc. on University Avenue during construction of the six-lane subway underneath University Avenue.

Construction of half a dozen overhead structures to provide for entering highways.

Providing proper detours for necessary traffic during construction.

Temporary bridge and detour for use of traffic while San Diego River bridge is being constructed.

Salvaging top soil for future landscaping and obtaining imported borrow to provide satisfactory subgrade for the pavement and numerous other details as are usually encountered on the average project.

Iulti-Lane Highways ncreasing In U. S.

United States improved highway xceeding two-lane widths amounts to 1,070 miles, according to the Amerean Association of State Highway fficials. New York leads with 926 miles of three-lane arteries. Pennsylvania is next with 905 miles. Illinois has 548 miles of four-lane motorways and Michigan follows with 394.

California has 90 miles of five-lane highway and 39 miles of six-lane. Michigan leads the six and eight-lane classifications with 101 and 22 miles, respectively. Montana and Wyoming are the only States that do not have any roadway exceeding two lanes in width.

Despite a considerable mileage of existing four-lane highways, the percentage of this mileage that is of modern design, divided-lane construction is negligible. This figure is probably less than 1,000 miles.

Redwood Timber Deflectors Built on Eel River

(Continued from page 1)

lapped six inches and tied with four strands of 14-gauge galvanized wire laced over and under the mesh at one-foot intervals. The placing of wire mesh, gravel backfill and the roadway embankment around the deflectors was carried on concurrently with the erection of the logs.

New sacked concrete riprap was constructed on the new embankment at Greenlaw Bluffs between the north end of the existing riprap and the first deflector. A timber crib was constructed on top of the deflector and carried up to the elevation of the top of the new riprap to provide a means of tying in the riprap to prevent scour during high water. Wire and rock mattresses were constructed along the toe of the existing riprap where it needed such protection.

Between the first and second deflectors at Greenlaw Bluffs there is a group of large redwood trees which were seriously undermined during the previous winter. A timber crib was therefore constructed, tying in with the first deflector and supporting the ground under the trees.

The timber deflectors average 38 feet in overall height, 60 feet in width, 90 feet in horizontal depth and extend into the river a distance from the center line of the highway of 100 feet. A total of 15,120 lineal feet of logs entered into the construction of the log deflectors. In other terms this would be 500,000 board feet or enough to construct thirty average size dwelling houses.

The total cost of the deflectors, including excavation, redwood timber, wire mesh and gravel backfill was $32,000, or an average of $8,000 for each of the four deflectors. The total construction cost of the project was approximately $70,000.

With emphasis on rural highway safety and National defense, eight thousand local units of the National Grange will compete during the next six months for awards offered by the farm group to Granges which make the greatest contribution to community highway safety each year.

In Memoriam

Hartley R. Church

Hartley R. Church, Associate Highway Engineer in the Department of Public Works, Division of Highways, District V, San Luis Obispo, succumbed to a heart attack while vacationing in San Francisco, April 21, 1941.

Mr. Church was born November 13, 1876, in Remington, Indiana. He was a graduate in engineering from Earlham College, Richmond, Indiana, and a member of the American Society of Civil Engineers.

His earlier activities included railroad and municipal service in the Middle West and in Central California.

He entered State service in February, 1922, with the Division of Highways, District III in Sacramento, being employed in both office and construction activities. In February, 1926, he transferred to District V at San Luis Obispo where he remained until his untimely death. His activities in District V consisted of the handling of permits and his contacts won him a host of friends throughout the State.

Mr. Church was a member of King David Lodge No. 236, F. and A. M. of San Luis Obispo. He was active in the church and an ardent worker in the Boy Scouts and worthy local activities. He was a veteran supporter of the C.S.E.A., having served in nearly every office of San Luis Obispo Chapter 10.

He is survived by his wife and two sons, Osmon and Robert.

His passing has taken an honored and esteemed friend from his fellow workers who extend their deepest sympathy and consolation to the members of his family.

On September 22d the Seventh Annual Western Safety Conference opens at the Olympic Hotel in Seattle. This conclave will be attended by safety experts and others vitally interested from the eleven western States and Alaska, British Columbia, Hawaii, Texas and Mexico.

Highway Bids and Awards for the Month of April, 1941

INYO AND MONO COUNTIES—Between Laws and Benton Station, about 2.1 miles to be graded, bituminous surface treatment applied for a length of about one mile and penetration treatment applied for a length of about 1.1 miles. District IX, Route 76, Sections A, B. Contract awarded to Shea & Beebe, Hawthorne, Nevada, $14,183.

LOS ANGELES COUNTY—Over North Figueroa Street at Park Row, a bridge consisting of reinforced concrete slab spans and an open spandrel arch to be constructed. District VII, Route 165, Section L.A. The Contracting Engineers Co., Los Angeles, $29,960; Carlo Bongiovanni, Hollywood, $33,999; J. E. Haddock, Ltd., Pasadena, $39,469; Werner & Webb, Los Angeles, $51,132. Contract awarded to J. S. Metzger & Son, Los Angeles, $29,705.

LOS ANGELES COUNTY—Traffic signal system on Firestone Blvd., between Central Avenue and Alameda Street to be furnished and installed. District VII, Route 174, Section B. Martin J. McCarthy, Los Angeles, $5,450. Contract awarded to Econolite Corp., Los Angeles, $5,282.

LOS ANGELES COUNTY—Between Fairfax Ave. and La Brea ave. about 1.0 mile to be surfaced with asphalt concrete and portions of base to be constructed of Portland cement concrete. District VII, Route 162, Section A. Nick Perscallo, Los Angeles, $60,788; J. E. Haddock, Ltd., Pasadena, $64,324; P. J. Akmadzich, Sunland, $66,332; Chas. H. Johnston, Los Angeles, $71,360. Contract awarded to Oswald Brothers, Los Angeles, $59,427.

LOS ANGELES COUNTY—A bridge consisting of two 52-foot 6-inch and one 75-foot steel beam spans over North Figueroa Street at Castelar Street to be constructed. District VII, Route 165, Section L.A. Carlo Bongiovanni, Hollywood, $58,765; J. S. Metzger & Son, Los Angeles, $59,819; W. J. Disteli, Los Angeles, $64,092; J. E. Haddock, Ltd., Pasadena, $64,588. Contract awarded to Contracting Engineers Co., Los Angeles, $56,694.

LOS ANGELES COUNTY—At Mill School, about 0.3 mile to be graded and surfaced with plant-mix surfacing. District VII, Route 170, Section B. Griffith Co., Los Angeles, $10,274; Chas. H. Johnston, Los Angeles, $14,412. Contract awarded to J. E. Haddock, Ltd., Pasadena, $8,802.

NAPA COUNTY—Between Calistoga and 0.2 mile north, about 0.7 mile in length to be graded and surfaced with road-mixed surfacing. District IV, Route 49, Sections A, Cstg. E. A. Forde, San Anselmo, $21,806; Claude C. Wood, Lodi, $22,937; Louis Biasotti & Son, Stockton, $23,205; Lee J. Immel, Berkeley, $25,714; J. L. Conner & Sons, Calistoga, $29,605. Contract awarded to Harold Smith, St. Helena, $20,263.

SAN BERNARDINO COUNTY—Between Power House and one-half mile east, about 0.6 mile to be graded and bituminous surface treatment applied and a reinforced concrete bridge to be constructed. District VIII, Route 190, Sections D, E. Matich Bros., Elsinore, $83,976; J. E. Haddock, Ltd., Pasadena, $91,644; Ralph A. Bell, San Marino, $95,490. Contract awarded to Geo. Herz & Co., San Bernardino, $78,123.

When you arrive at the point where you know how little you know, you have arrived at the beginning of knowledge.

State of California

CULBERT L. OLSON, Governor

Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

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FRANZ R. SACHSE, Assistant Director

MORGAN KEATON, Deputy Director

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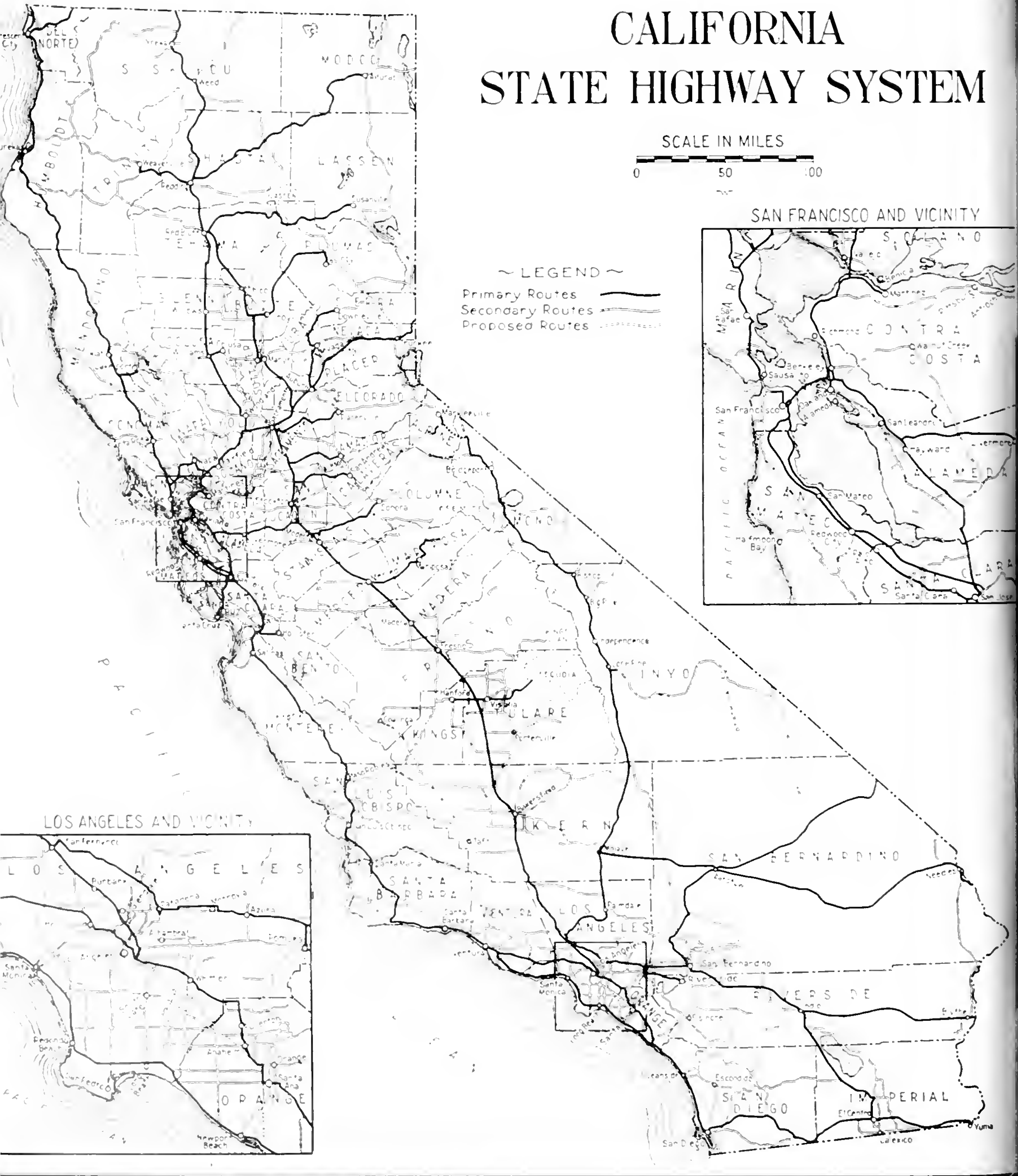

CALIFORNIA
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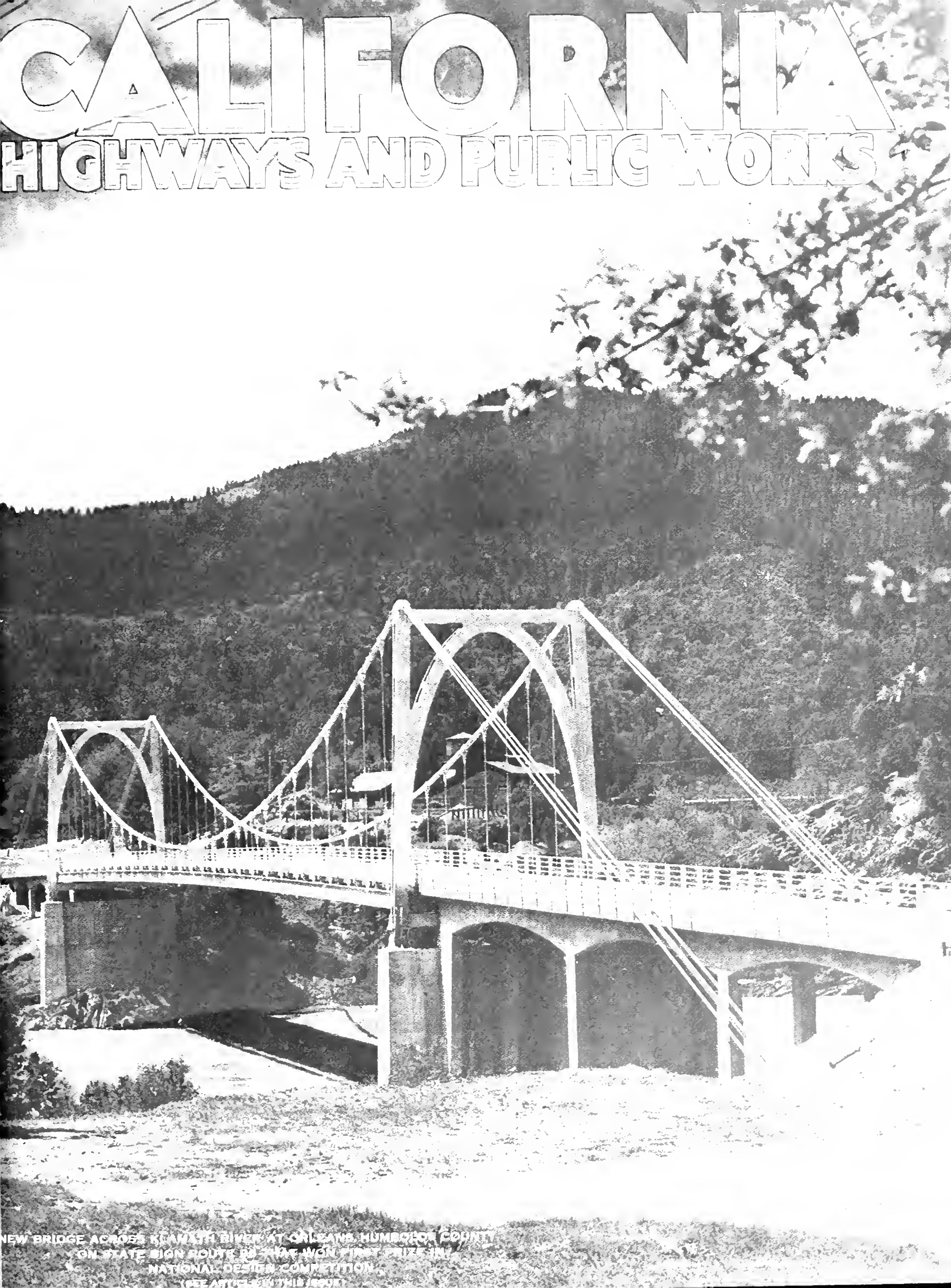

NEW BRIDGE ACROSS KLAMATH RIVER AT ORLEANS, HUMBOLDT COUNTY ON STATE SIGN ROUTE 96, THAT WON FIRST PRIZE IN NATIONAL DESIGN COMPETITION
(SEE ARTICLE IN THIS ISSUE)

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California

FRANK W. CLARK, Director   C. H. PURCELL, State Highway Engineer   J. W. HOWE, Editor   K. C. ADAMS, Associate Editor

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Vol. 19   JUNE, 1941   No. 6

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$22,053,979 Total Revenues of Bay Bridge in Fifty-one Months. Total Traffic 47,950,012 Vehicles

STATE ownership and operation of the San Francisco-Oakland Bay Bridge has proved highly ccessful in every way as a public rvice undertaking, as is well evineed by the current report of indendent accountants for the California oll Bridge Authority covering the tal traffic and revenues of the bridge om its opening up to February 28, 41. The report shows total reveles of more than $22,000,000 with excess revenue of over $10,000,000 ove expenses including bond intert despite five successive toll reducons.

Another outstanding exemplificaon of what State operation of toll idges can accomplish is the reducon of rates on the Carquinez and ntioch spans purchased by the State st September.

TOLL REDUCTIONS

When the Bay Bridge was opened traffic on November 12, 1936, the ll for an automobile with driver id four passengers was set at 65 nts. Today the toll is 25 cents.

When the State acquired the Carinez Bridge the charge for an tomobile was 65 cents and 10 cents r each additional passenger. Today e rate is 30 cents per car with no arge for extra passengers.

Truck and bus tolls on all three ate-owned bridges have been submtially reduced. In the case of e Carquinez and Antioch spans, uck charges have been lowered pproximately 12 per cent; passenr tolls by more than 50 per cent.

The records made by the three ridges are unimpeachable proof of hat public ownership can accomish.

BENEFITS TO PUBLIC

The report of the accountants shows iat the total revenues of the San rancisco-Oakland Bay Bridge from le date of its opening to February 3, 1941, amounted to $22,053,979.11, aid principally by motorists.

San Francisco-Oakland Bay Bridge Statistics

Bridge Opened	November 12, 1936
Revenues to February 28, 1941	$22,053,979.11
Expenses Other Than Bond Interest	$142,956.96
Interest on Bonds	$11,430,623.06
Excess of Revenues Over Expenses	$10,480,399.09
Total Bond Retirements	$5,800,000.00
Bonds Outstanding	$67,200,000.00
Bonds Originally Issued	$73,000,000.00
Balance on Hand Cash and U. S. Bonds	$4,790,382.01
Motor Vehicle Traffic	47,950,012
Vehicular Toll Revenues	$20,834,825.00
Railway Passengers Carried	40,938,794
Revenue From Railways	$1,023,470.23
Total Vehicular and Railway Revenues	$21,858,295.23
Other Income (Rents, Interests on Deposits, etc.)	$195,683.88

TOLL REDUCTIONS

February 1, 1937	From 65¢ to 50¢
June 15, 1939	From 50¢ to 40¢
January 1, 1940	From 40¢ to 35¢
May 25, 1940	From 35¢ to 30¢
June 24, 1940	From 30¢ to 25¢

Out of these revenues, expenses other than bond interest totaled $142,956.96. Interest on bonds amounted to $11,430,623.06, leaving a balance of $10,480,399.09, representing excess of revenues over expenses.

This showing was made in spite of four successive toll reductions which were put into effect within a 12-month period by the California Toll Bridge Authority in line with the policy of Governor Culbert L. Olson to let the motoring public reap the fullest possible benefits from State ownership and operation of the span. In reducing automobile and truck tolls on the Carquinez and Antioch bridges the Governor and the Toll Bridge Authority have been motivated by the same principle.

The goal of a 25-cent passenger automobile toll on the Bay Bridge was attained on June 24, 1940. The first reduction was on February 1, 1937, from 65 cents to 50 cents. The second, which was effected by the present Toll Bridge Authority, was on June 15, 1939, from 50 cents to 40 cents; the third on January 1, 1940, from 40 cents to 35 cents; the fourth on May 25, 1940, from 35 cents to 30 cents, and the fifth to 25 cents on June 24, 1940.

INTEREST RATE REDUCED

The reductions from 50 cents down to 25 cents were greatly aided by negotiations in Washington between Director of Public Works Frank W. Clark and attorneys representing the Toll Bridge Authority and Jesse Jones, chairman of the Reconstruction Finance Corporation, which originally loaned the money for the Bay Bridge. These negotiations were concluded in May, 1939, with the result that the rate of interest on the $40,000,000 San Francisco-Oakland Toll Bridge Sinking Fund revenue bonds was reduced from 4¼ to 4 per cent. The Toll Bridge Authority was further able to secure a concession from the R. F. C. under which the State was allowed $1,065,000 credit on its share of the sale price premium on the sale of the

(Continued on page 12)

Bridge across Klamath River winner of national award for most beautiful steel bridge costing less than $250,000 built in 1940

Orleans Bridge Wins First Prize in National Design Competition

THE Division of Highways learned on May 22d that the new suspension bridge over the Klamath River at Orleans had received the annual award of the American Institute of Steel Construction for the most beautiful steel bridge in Class "C." All steel bridges costing less than $250,000 and completed and opened to traffic during the year 1940 were eligible to compete for this award.

The structure is located on the Klamath River Road, which is State Sign Route No. 96, and it was built to replace an old suspension span with timber floor and towers that had reached a dangerous condition because of decay. This old structure had an eight-foot roadway width that required all drivers to wait at the end of the bridge until an oncoming driver had crossed.

Because the low water season in this region is very short and the stream is subject to sudden rises, it was considered necessary to avoid constructing falsework in the channel. This decision was further supported by the fact that the falsework piles could not be driven far enough in the stream bed to withstand high water.

It was decided therefore to construct a bridge of either the suspension or cantilever type, and comparative estimates indicated that the former would be the more economical.

The travel over this road is largely recreational and it passes through a rugged, tree-covered country. The beauty of the landscape called for a suitable structure, and that such has been attained is proved by the award.

The suspended span of the new bridge is 360 feet long and there are 135 feet of reinforced concrete girder spans on the west and 170 feet on the east. Although traffic on this highway is comparatively light, it is subject to occasional very heavy loads of machinery, lumber, etc., so it was considered advisable to design it for the heaviest design loading used by the Highway Department. This loading is known as the H20-S12 and consists of 20-ton truck followed by 12-ton trailer axle.

Each of the main cables consists of four 3-inch 7/37 wire ropes arranged in an open group. These cables were designed for a dead load of 3,475 pounds per lineal foot of bridge and a uniform live load of 15 pounds per square foot of roadway. They were prestressed for one hour at 200 tons, then measured and marked at 100 tons, which load corresponded to approximately the dead load stress in the cables. The positions of the tower saddles and the suspender cables were painted on the main cables to facilitate erection, and a longitudinal stripe was painted on them in their prestressed condition to insure that there would be no untwisting of the cables when erected. All ropes, both main cables and suspenders, were socketed to their prestressed length in the shop, and no adjustment was required for erection.

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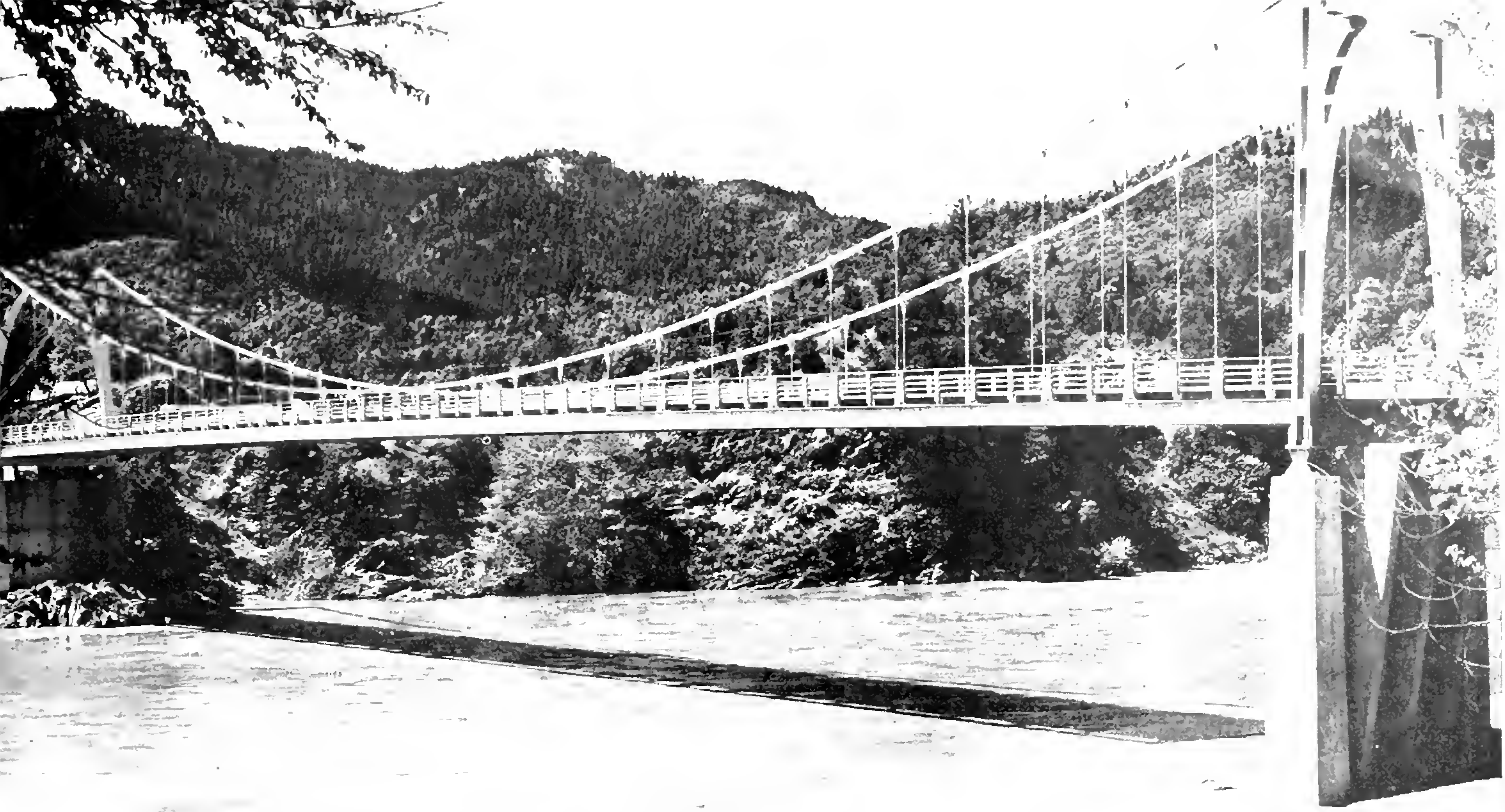
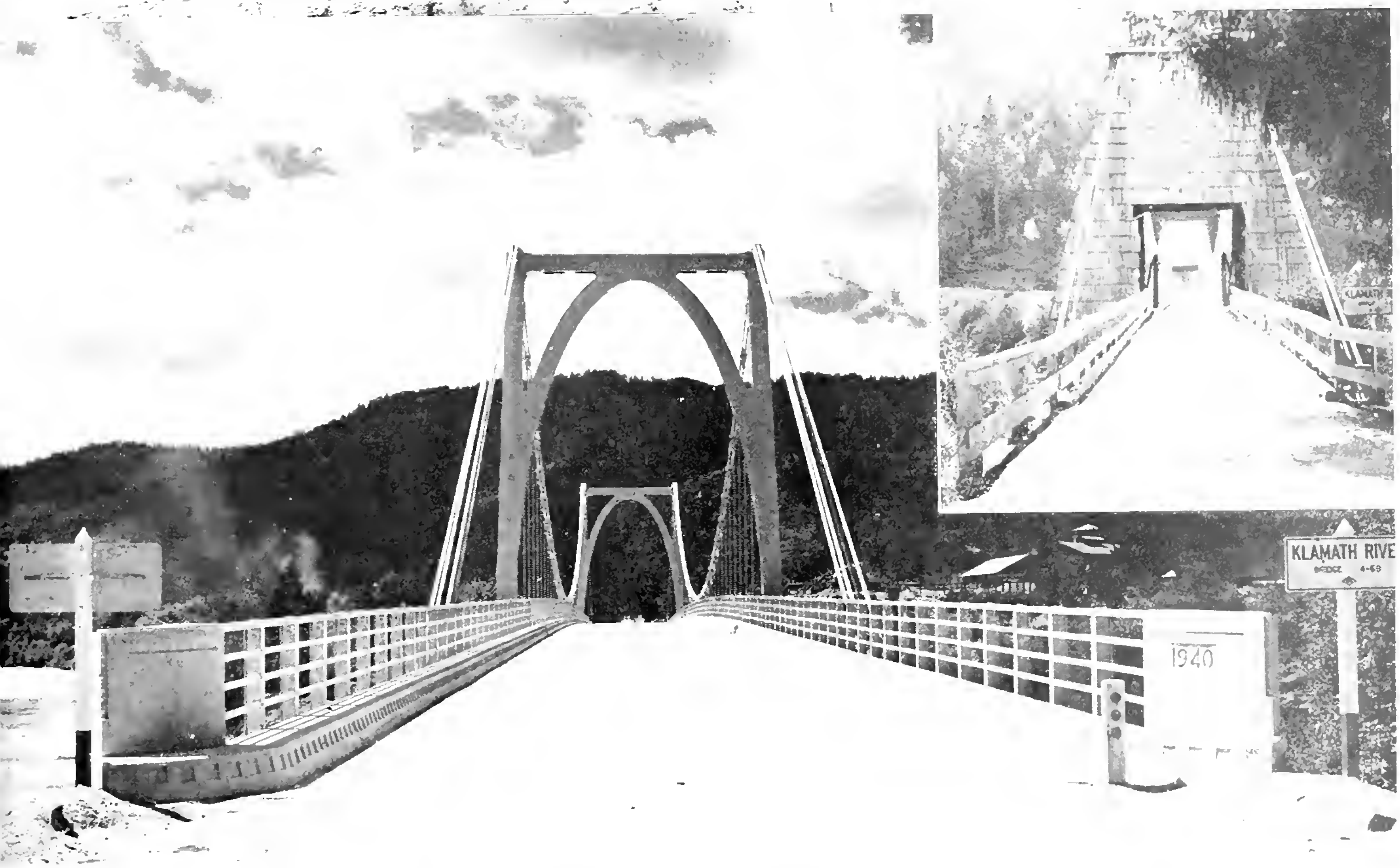




Construction features of the Orleans bridge are the steel towers, each consisting of two columns with elliptically shaped cross braces forming an arch over the roadway, and the prestressed open group cables. Inset shows the old, narrow bridge with timber floor and towers that permitted only one-way traffic

Madera-Friant Cooperative Project Completed and Officially Dedicated

THE hazardous rolling grade on State Highway Route 126 in Madera County extending easterly from Madera on that city's approach road to Friant Dam and Yosemite Valley has been eliminated. The series of blind vertical curves on the old road have been replaced by a modern highway with 36-foot roadway and long, 2,300-foot sight distances.

Over six miles of highway were reconstructed as a Works Progress Administration project sponsored by the State Division of Highways and the State Relief Administration and participated in to a considerable extent by the county board of supervisors.

The completed project, which is a fine example of cooperation of various agencies participating on a single highway undertaking, was officially dedicated on Sunday morning, May 25. Dedicatory ceremonies were held on Cottonwood Creek bridge eight miles east of Madera and ten miles from Friant Dam, one of the major units of the Central Valley Project.

Federal, State, county and municipal officials took part in the celebration. A short program of speechmaking preceded a luncheon served at Bass Lake under the auspices of the Madera County Chamber of Commerce, which arranged for the dedication.

Representing Director of Public Works Frank W. Clark, whose official duties prevented him from attending, Deputy Director Morgan Keaton headed the list of speakers.

"Not only will this highway become a main thoroughfare to and from the Friant Dam unit of the great Central Valley Project," Mr. Keaton said, "but there will be attracted to this route a considerable portion of the recreational traffic to Yosemite, the Big Trees, and the many beauty spots in the High Sierras which lie to the north and east of this section of California."

Short talks were made by Highway Commissioner Iener Nielsen of Fresno; Ralph G. Wadsworth, Deputy Administrator of WPA, San Francisco; Ray Adell, Chairman of the Board of Supervisors of Madera; J. W. Halleen, California State Chamber of Commerce; and Mrs. Charles Moses, who represented Governor Culbert L. Olson and who cut the ribbon stretched across the new highway at the conclusion of the speechmaking.

WPA SUPPLIED LABOR

W. S. Hillis, Chairman of Madera County Chamber of Commerce Road Committee, presided at the dedication and introduced the speakers.

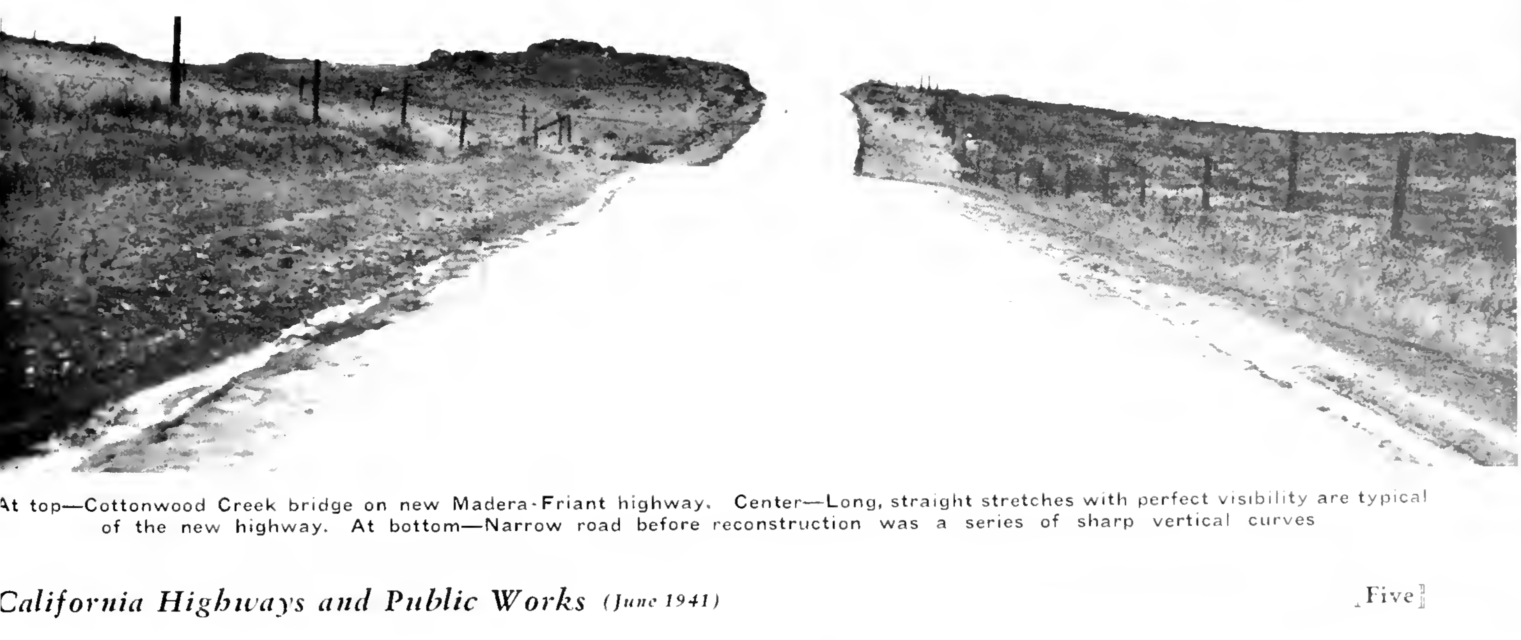
Plans, specifications and all other engineering and inspection work on the project were furnished by the Division of Highways. The Works Progress Administration furnished the labor and a portion of the equipment and nonlabor items.

For men taken off of relief work on this project the State Relief Administration contributed at the rate of $6 per man month. With 150 to 300 men of this status the SRA's contribution made available a considerable sum, for the purchase of materials and supplies as well as for the rental of equipment.

Appreciating the importance of this road to the community, every supervisor in Madera County loaned equipment fully supplied and operated, to the job. They furnished

(Continued on page 19)

Complying with W.P.A. regulations dirt was moved by wagon trains filled by hand labor and hauled by tractor



At top—Cottonwood Creek bridge on new Madera-Friant highway. Center—Long, straight stretches with perfect visibility are typical of the new highway. At bottom—Narrow road before reconstruction was a series of sharp vertical curves

Development of Bridges to Meet State Highway Traffic Demands

By STEWART MITCHELL, Senior Bridge Engineer

WHY bridges?

For crossing rivers is the most obvious answer. Bridges are still needed for this time-honored purpose but the use of structures has been extended so that they now aid the engineer in surmounting many other obstacles that he encounters in highway construction. And along with more extensive uses we find that the conditions to which structures must be adapted have become exceedingly complex.

In moving himself and his belongings from place to place, man always has been faced with the necessity of overcoming obstacles presented by the terrain; obstacles that are often aided and abetted by the elements. The passage of large rivers has ever been one of his most serious problems and we find mention of bridges in our earliest records. Every schoolboy knows that some bridge in the days of Rome was defended single-handed against her enemies by a lad named Horatius; and London Bridge, the Brooklyn Bridge and lately our own San Francisco Bay Bridges are familiar milestones in bridge history.

INNUMERABLE MINOR BRIDGES

Of course, large structures like the Bay Bridges are the prima-donnas that can hold the spotlight. Wherever they choose to stand, traffic is led to their portals by the most convenient and expeditious method that can be found. However, let us think of the multitude of humble structures that cross innumerable creeks, ravines, arroyos, washes, or what have you—obstacles to be taken in stride by the smooth-curving, high-powered highways that today carry automobile traffic with the minimum of inconvenience over endless miles. We must also consider prosaic structures such as those usually found in more populous areas helping to separate streams of cross traffic and railroad grade crossings.

Now, while any one of these relatively minor structures can produce an engineering headache as well as can the construction of a large one, in the aggregate they present just as serious an economic headache as the most monumental single structure ever built. Undoubtedly they are lacking in news appeal but they are not entirely devoid of glamour. They serve to carry precious lives around dizzy precipices with safety as well as to substitute for a lowly dirt fill when the terrain can not be trusted to carry a heavier load.

The part that bridges have taken in the development of highway traffic is an interesting part of California history. Within the relatively short period which it covers, rapidly changing economic conditions together with constantly accelerated improvement in means of transportation and in methods of highway construction, present a kaleidoscopic picture. It can only be touched on in the space allotted here.

EARLY DAY STRUCTURES

First we picture the days of the pioneer and the Spanish rancho. Then came the gold mining era which, in time, merged with a great industrial and intensively agricultural development to form the political and economic body that is California today. Modes of travel were first the ox or mule team and the Conestoga wagon of the emigrant, then the Concord stage coaches and long-drawn-out teams straining ahead of heavily loaded freight wagons. The coming of the railroads in the '70s relegated roads to a secondary role and retarded their further growth until the advent of the auto, development of which is largely a matter of the past two decades.

The highway locator of the early '50s sought for what he called good "natural" road since funds available for construction were pitifully small viewed in the light of present day expenditures. They were only sufficient to permit improvement of some of the worst places by removal of rocks and trees and perhaps to level off a few places where side hills could not be well avoided. Streams usually had to be forded. Then gold brought increased wealth and more people and it became necessary, as well as profitable, to spend more for building and maintaining roads and bridges. The usual method of financing such works was through private capital which was reimbursed through the right to collect tolls, and it is stated that the first bridge over the South Fork of the American River at Coloma cost $20,000 and paid for itself in 90 days. That apparently was the heyday of "rugged invididualism."

FIRST STATE BUREAU

With the completion of the Central Pacific Railroad across the Sierras and a decline in the gold mining orgy, there began a "dark age" of road building whose renaissance was inaugurated by the formation of a State "Bureau of Highways" in 1895. The bureau, which existed from 1895 to 1897, collected data and made what are now seen to be some very intelligent suggestions as to a future road program in this State.

Nothing happened except that certain existing county roads and some new roads in the mountainous regions, where building and maintaining roads was considered to be beyond the financial ability of the counties, were put under the jurisdiction of the State by legislative acts. Appropriations for work on these roads were small, and the magnitude of the bridge construction carried on at the time may be judged from the following extract from the report of the Lake Tahoe Wagon Road Commissioner in 1902: (This road reached from Placerville to the State line.)

"The Legislature of the State, at the regular session in 1901, appro-

A multi-purpose structure involving problems of horizontal and vertical clearance, super elevation and intricate construction

riated the sum of $9,200 for the alary of the commissioner and maintenance of the highway for the two ears beginning July 1, 1901.

"By exercising the strictest of economy, the appropriation is sufficient o keep the road in repair until the nd of the fiscal year, and as a result f the expenditures so far made, I ave been able to keep the road in ood shape, while in addition I have onstructed **four new bridges, 27 tone culverts, and repaired a numer of retaining walls.**

"I was also compelled to expend early $500 of this appropriation in rder to complete the stone bridge t Riverton.

"Some of the present structures in he shape of bridges are very old, and earnestly solicit the consideration f the proper authorities to the necessity of granting a somewhat larger ppropriation at the next session of he Legislature for the purpose of mprovement along the line indiated."

Under the Savage Act of 1907, several counties bonded themselves for oad improvement and in 1910 the rst bond issue amounting to $18,-00,000 was voted for the construcion of a State highway system. The utomobile was then getting to be a actor in "good roads" movements nd those events may be said to mark the beginning of modern highway development in California.

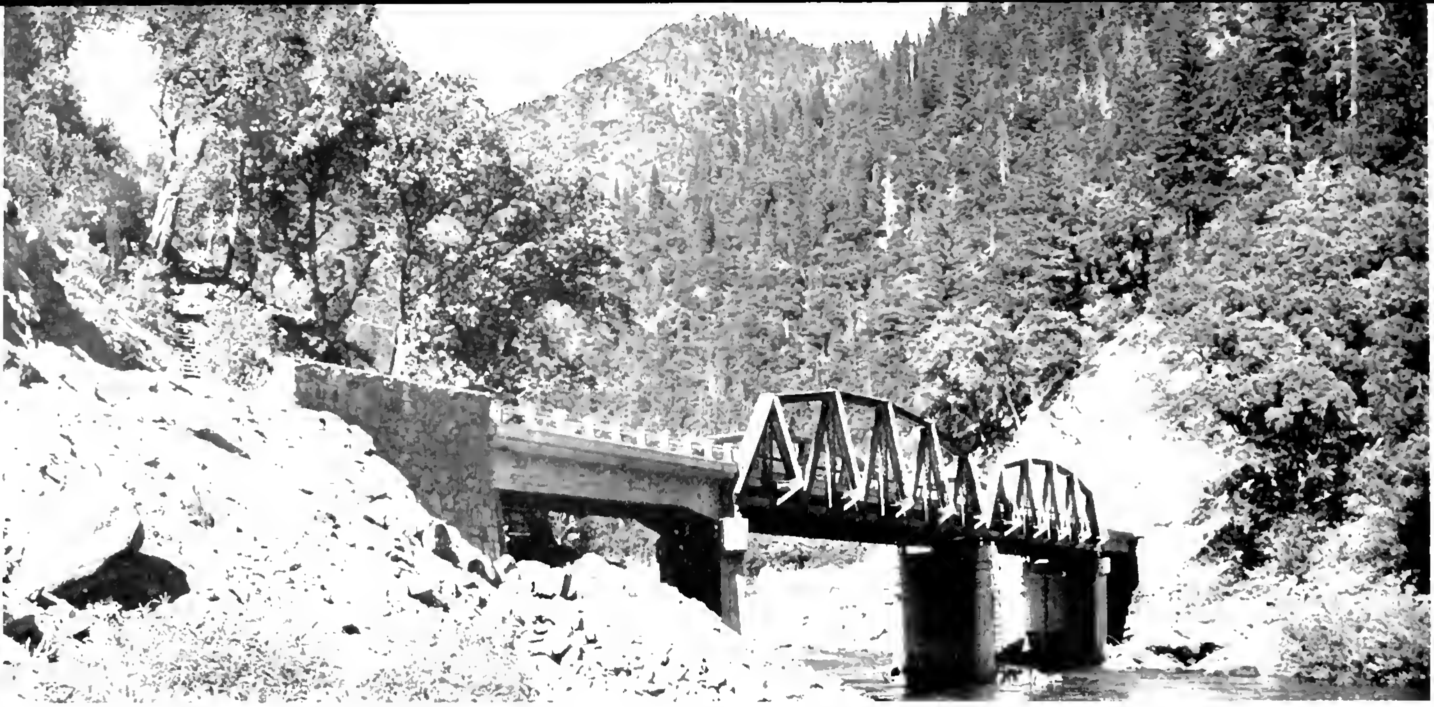
At the start, automobiles were low in power and few in number. They had great difficulty in climbing the hills found on the roads of that era and their maximum speed was unimpressive under the best of conditions. In consequence, highway locations were predicated on obtaining a favorable gradient, not to exceed a very modest maximum, and were satisfied with comparatively low standards of alignment and sight distance.

In building a bridge, the most favorable and shortest crossing in the immediate vicinity was chosen, with practical assurance that the road could be curved and twisted to meet it.

SUBSIDIARY TO ROAD

However, automotive equipment increased in power and number so there was a drift toward high-speed alignment requiring long sight distance and easy curves, even if somewhat steeper grades were required to get it. The public's growing demands in this respect, and its willingness to pay the cost, has resulted in standards of highway location that relegate bridges and other structures to a subsidiary role. They have become but parts of the roadbed—admittedly very expensive parts.

The "cost per mile" for structures on the highways seems to increase as time goes on. During the days of the Spanish occupation, traffic up the San Joaquin Valley followed the barren foothills of the Coast Range. Here crossing the dry stream beds of the small arroyos offered no obstacles to travelers of that day except for very short and infrequent periods during winter storms. The emigrant after crossing the high passes in the Sierras followed the high snowy ridges wherever it was possible on his way down to the valley. He took a chance on having to travel through snow rather than face greater difficulties connected with the crossing of canyons and streams that go with following the lower country along the rivers. Likewise, the old "Stockton-Los Angeles Road," a part of which was used by the Butterfield Stages, followed the base of the hills along the east side of the San Joaquin Valley, crossing the large Sierran streams before they spread out into the numerous channels and sloughs of the valley floor. (Note: For those geographically inclined, this road is now marked by the cities of Porterville and Reedley, the site of old Millerton soon to find a watery grave behind Friant Dam, and the Merced-Mariposa County line.)

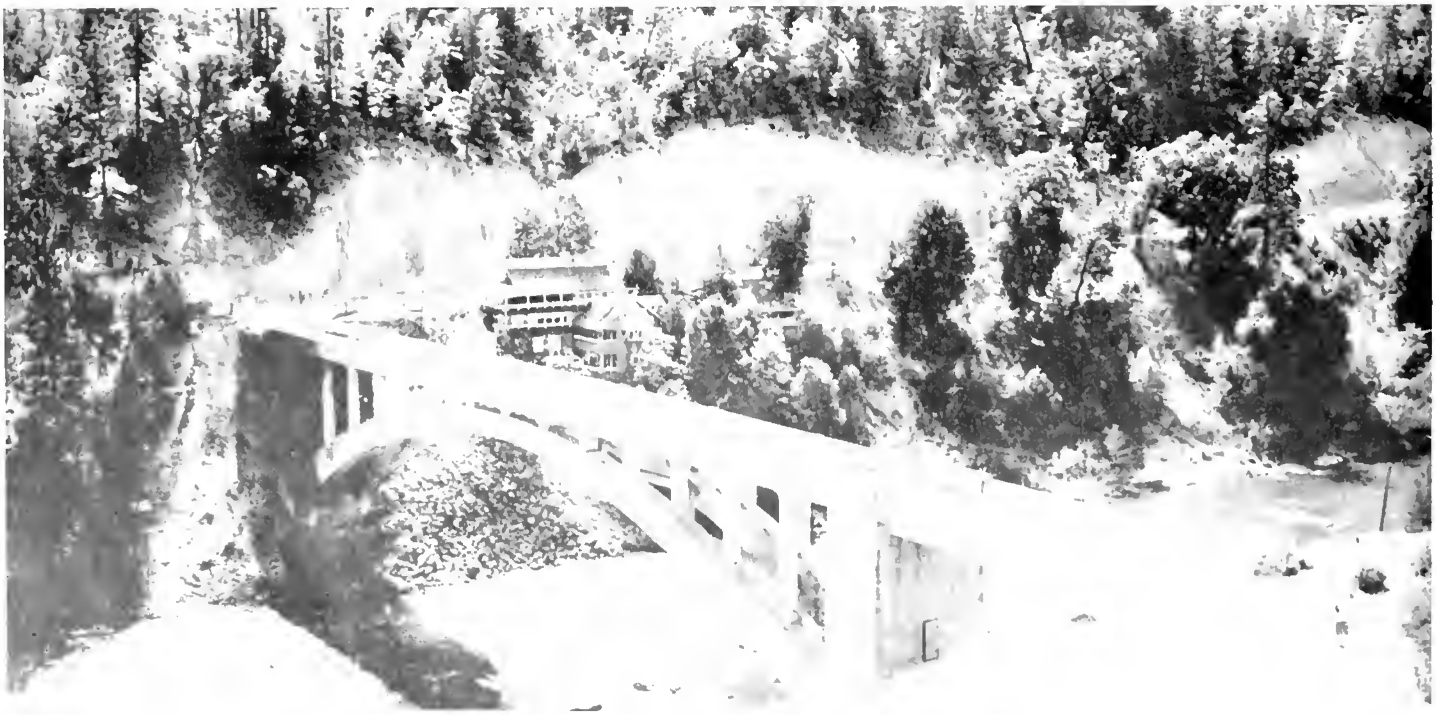


A bridge on high speed alignment at a favorable location but nevertheless it had to be skewed and super-elevated

The growth of farming and the building of railroads made it necessary to build roads across the valley plain. There was also a demand for more nearly "all-year" roads, all of which meant more bridges—or ferries on the larger streams serving until a bridge could be built. At first the bridges were built short and with inexpensive foundations, limited only by the builder's willingness to gamble on the probable high water of the next winter or two. He built the cheapest bridge that he felt had a chance of lasting long enough to return him his investment, and bring him a maximum of profit from tolls in proportion to its cost. The economic principles followed in that day were simple and concerned themselves only with the crude ideas of out-of-pocket cost and probable cash return.

Let us skip over to the revival of highway building which, as already mentioned, is associated with the growing use of automobiles. At first, the only noticeable difference was in the building of a better class of bridges than heretofore, and a more comprehensive use of smaller drainage structures like pipes and box culverts.

There began to be built modest structures separating the grades of highways and railroad tracks, cross-



An older bridge located so as to obtain the most economical crossing but with little regard for highway alignment

A "dry land" bridge on a summit used in place of a more expensive fill with retaining walls

ng at right angles and at physically avorable locations only. Engineers hen grew bolder and in order to preerve the desired alingment, designed heir structures to cross the rivers nd railroads at a considerable angle, r even on a curve! Now the reuirements of modern stream-lined ocation are likely to demand such a harp angle of crossing that the ridge engineer is hard put to decide hen, if ever, he has reached the pposite bank and can stop his ridge. Furthermore it is now often ecessary to locate a crossing where he terrain is less favorable or the oundation material is less solid than t is at some other point nearby.

MODERN EXACTING REQUIREMENTS

As roadways grow wider, so must he structures be widened or dupliated. To get better alignment it may e necessary to cross over a stream nd back again when there is better round on the opposite side, or sideill viaducts may be built to get by stretch of rugged terrain. In the eavily populated areas, highway seprations, with necessary provision for raffic interchange, are needed more nd more. All of this tends to skyocket the cost of structures in proortion to the mileage of highways.

The more exacting requirements of nodern highway construction have rought about many structural and economic problems which were of negligible importance when less pretentious standards were in vogue. In order to fit the smooth and easy riding roadways it is often necessary to design structures all or partly on curves with the floor tipped to conform with the complicated requirements of super-elevation.

Rigid requirements may fix the grade of the roadway and require a structure with a minimum depth of slab and girders in order to provide proper stream, railroad or roadway clearance. Bridge designers have had to resort to many ingenious schemes for doing this in a way that would not overstep the rules of good engineering practice. A little thing like a $\frac{1}{4}''$ sag in spans repeated with sufficient regularity will make a floor rough riding at certain speeds and contrary to common opinion, structures are not the rigid "immovable bodies" they may seem to be. Warping, shrinkage and temperature can progressively alter their shape to a noticeable degree, whether of steel, concrete or wood.

DIFFICULT PROBLEMS

Probably the most difficult problem is that of unequal settlement of the structure itself, or differential settlement between the structure and the adjacent road. This is particularly serious because of the deep cuts and high fills that are now common. Fills at the end of a bridge or over culverts can be so constructed, through present day techniques, that they are thoroughly compacted and stable. It is Mother Earth beneath the fill that is the problem child.

The materials composing a large part of California are such that settlement or movement under the weight of a high fill is considerable, and if it be moist clayey material, this settling may be a matter of months or years. The various detailed problems that arise because of this are too numerous and involved to go into here. They can be made the basis of an interesting story by themselves.

If there is a moral to this story, it is that bridges and the adjoining road can no longer be considered as separate structures. They are so intimately related that poor designing of the combination can nullify the best design practice applied to each of them separately. The only answer is proper understanding of each other's problems by the bridge and highway engineers and complete cooperation in solving them.

Doctor: "Humph! I can't quite diagnose your case. I think it's drink."

Patient: "Oh, I see. Now, look here, doctor. Would you like me to come again when you're sober?"

Gross Weight Provisions of Vehicle Code as Revised by Legislature

THE Legislature passed and Governor Olson signed Assembly Bill No. 1268 which revises the provisions of the Motor Vehicle Code regulating the gross weight of vehicles. The purposes of the revisions are to regulate the weight of heavy vehicles in a manner that will conform to the carrying capacity of our highway bridges.

The previous restrictions of the Vehicle Code were formulated and modified from time to time without regard to the structural strength of the bridges, and were fundamentally wrong in that the gross load which any given type of vehicle or vehicle combination could carry, was the same regardless of how concentrated were the axle loads.

It did restrict the allowable gross load on single vehicles to a reasonable degree, but it permitted loads of close coupled combinations that stressed the structural members of the bridges far above that contemplated in their design.

ENDS VEXATIOUS QUESTION

The adoption of the revised weight limit provisions ends a long series of studies and conferences involving the Department of Public Works, manufacturers, truck operators and the Highway Patrol. It is hoped that it will end a vexatious question and set a standard that the department and vehicle manufacturers can hold and build to for the future.

Back in 1932 the American Association of State Highway Officials adopted a recommended uniform code for regulating the maximum weight and size of highway vehicles. In this code the weight was governed by a maximum axle load and a formula which was W — c (L plus 40) where:

W — total gross weight, with load, in pounds;

c — a coefficient to be determined by the individual States;

L — the distance between the first and last axles of a vehicle or combination of vehicles, in feet.

They also stated that: "a value of 700 is recommended for "c" as the lowest which should be imposed, but this should not be construed as inhibiting greater values."

ENGINEERS PROPOSE CHANGE

The Association consists of State Highway Engineers of all the states, as well as representatives of the Public Roads Administration (known as the Bureau of Public Roads at that time) and the latter were largely instrumental in developing this formula.

About six years later the Western Association of State Highway Engineers, comprising highway officials of the 11 western states and of the Public Roads Administration, agreed that the value of the coefficient "c" in the formula should be 650 when applied to any and all groups of axles when the distance between the first and last axle was 18 feet or less. For greater distances between axles the coefficient should be 750.

The Division of Highways of California, after a further intensive study of the actual vehicles in use in the State, the conditions under which they had to operate and the structural strengths and service life of standard highway bridges built during the past 15 or 20 years, decided that the coefficients could be raised to 700 and 800, respectively. In doing this they had in mind a reasonable value which would protect the public investment in the bridges and highway and at the same time not depreciate unnecessarily the large investment in commercial hauling equipment.

MODIFICATIONS RECOMMENDED

Their recommendations were submitted to the Motor Vehicle Advisory Committee and, after considerable study and discussion by all the interests concerned, it was decided that some modification of the recommended restrictions would have to be made in order to amortize the investment in equipment constructed in good faith and operating in accordance with an existing law which had been in effect for many years.

A period of 10 years has been allowed for this purpose but even with these provisions, it will be necessary for some of the very short coupled combinations developed during the past year or so to reduce their loads or lengthen their axle spacings. It may be practicable to operate some of these under special permit on certain sections of the highway where there are no bridges, or only bridges of very short span, or where bridges have been designed for the heavier loadings only recently adopted by the department.

It must be noted that the revised restrictions were not necessary because of the sub-standard bridges alone. They are based on structures designed for the so-called "H-15" loading which has been used for the design of bridges throughout the United States for 20 years or more. Replacement of all "H-15" structures is impractical and it is of interest to note that the War Department has designed its equipment to conform with this standard.

MANY BRIDGES POSTED

There are many of the older bridges on the highway operating under a reduced safety factor at the present time whose service life, in consequence, is being shortened by the present allowable loads. These will get only partial relief under the new restrictions. There are other bridges posted for reduced load limits because the factor of safety has been reduced to the vanishing point under legal loads.

Unfortunately the latter must continue as posted bridges with little change in the degree of posting in most instances because the present postings were based on vehicles now in use and on a safety factor reduced considerably below that allowed in the design of new structures. The only remedy in their case is the expenditure of funds to strengthen or replace them, which, under present conditions, will be a matter of several years.

The following is a brief resumé of the new regulations and changes in the existing law:

Sections 702 and 703, which cov-
ed the gross load limitation on two-
:le and three-axle vehicles, has been
eleted and the weight on vehicles
to be regulated by the formulas
nd the maximum axle load. They
re also limited by the fact that
ads on a front axle can not normally
xceed 9,000 pounds because of con-
ruction and steering difficulties.

Section 704, which covered the al-
wable load on one-axle and on one or
ore wheels supporting one end of
n axle, has been changed to permit
8,000 pounds on one axle but only
500 on a wheel instead of the previ-
us 10,000. The exemption for ve-
icles registered prior to January 1,
930, which expires December 31,
942, is left unchanged.

Section 705 has been completely re-
sed and the following is a synopsis
f the new regulations:

1. Applicable to vehicles registered
n or after January 1, 1942, except
s noted below, and to all vehicles,
egardless of date of registration, on
r after January 1, 1952.

(a) The gross weight on a vehicle, in combination or otherwise, or on any combination of vehicles shall not exceed that given by the formula,

W = 800 (L + 40)

Where, W = the gross load in pounds on the vehicle or combination.

(b) The gross weight on any group of two or more axles, whether part or all of a vehicle or combination, when the distance between first and last axle of the group is less than 18', shall not exceed that given by the formula,

W = 700 (L + 40)

Where, W = the gross load in pounds of the group of axles considered.

L = the distance in feet between the first and last axle of the group being considered.

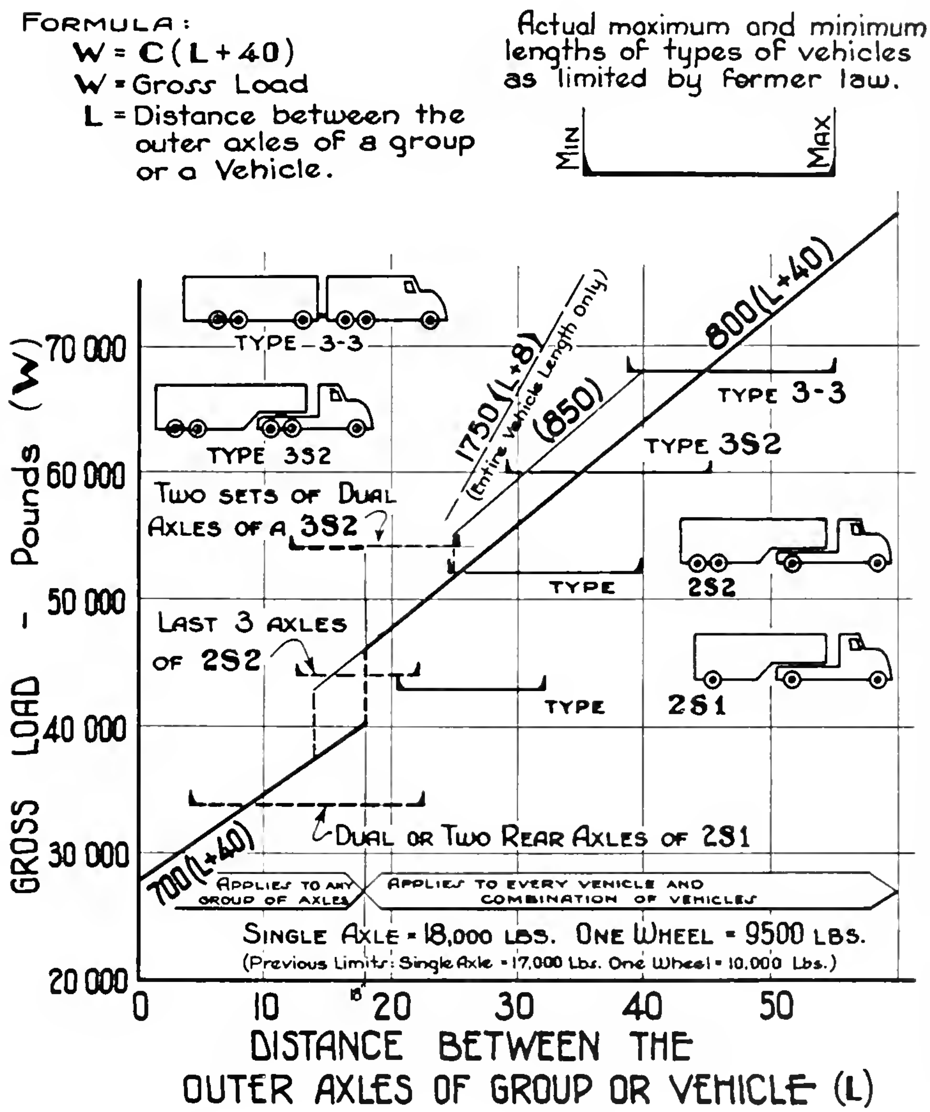
2. Exceptions to these provisions
ave been made, applicable only to
ehicles registered before January 1,
942, and terminating January 1,
952, applying only within the axle
pacings given:

(a) The gross weight on a vehicle, in combination or otherwise, or on any combination of vehicles, when such vehicle or combination has a distance between its first and last axles of 25 feet or more, but not more than 45 feet, shall not exceed 68,000 pounds, *and* that given by the formula,

W = 850 (L + 40)

Where, W = the gross load in pounds on the vehicle or combination.

ACTUAL GROSS VEHICLE LOADS PERMITTED BY THE NEW CALIFORNIA MOTOR VEHICLE CODE RESTRICTION COMPARED TO THE FORMER LIMITS



L = the distance in feet between the first and last axle of the vehicle or combination.

(b) The gross weight on any group of two or more axles, whether part or all of a vehicle or combination, when the distance between the first and last axle of the group considered is 14 feet or more, but is not more than 18 feet, shall not exceed that given by the formula,

W = 800 (L + 40)

Where, W = the gross load in pounds of the groups of axles considered.

L = the distance in feet between the first and last axle of the group being considered.

It should be noted that all the provisions either of 1 or 2, and the maximum axle loads, are applied simultaneously to govern the gross weight.

The chart gives a graphical picture of the old and new load limits. The sloping lines obtained by plotting the formulas show that the gross load increases as the wheel spacing is lengthened. The horizontal lines show that the same load could be carried regardless of the axle concentrations under the old law. Vehicles with close-coupled axles represented by portions of the horizontal lines to the left of the sloping lines will have a lower maximum gross load or must lengthen their axle spacing.

Total Revenues and Traffic of Bay Bridge During 5 Years

(Continued from page 1)

bonds to the underwriters, thereby reducing to $71,000,000 the total of outstanding bonds at that date and saving the interest on $1,500,000 of bonds to be redeemed, which was $60,000 per year.

TOTAL BOND RETIREMENTS

Since November 12, 1936, there have been retired Bay Bridge serial revenue bonds par value amounting to $1,110,000 and sinking fund bonds totaling $3,190,000. Other prior year retirements not made out of revenue funds included $300,000 of serial revenue bonds and $700,000 of sinking fund bonds retired out of Reconstruction Finance Corporation participation and $500,000 of serial revenue bonds retired out of construction funds.

Total bond retirements to February 28, 1941, were $1,910,000 of serial revenue bonds and $3,890,000 of sinking fund bonds.

The bonds outstanding as of February 28, 1941, were $31,090,000 serial revenue bonds and $36,110,000 sinking fund bonds.

Bonds originally issued were $33,000,000 serial revenue bonds and $40,000,000 sinking fund bonds, making a total of $73,000,000.

VEHICLES PAID $20,834,825

On February 28, the Bay Bridge had a balance of $4,790,382.01 representing cash on hand and investment in United States bonds.

Since November 12, 1936, a total of 47,950,012 vehicles have used the bridge. Vehicular toll revenues for that period amounted to $20,834,825. The bridge railway system carried 40,938,794 toll passengers with an accruing revenue to the bridge of $1,023,470.23, making the total of vehicular and railway revenues $21,858,295.23. Other revenues from rents, interest on reserve bank deposits and bank balances, etc., amounted to $195,683.88.

Toll traffic to the Exposition on Treasure Island and the revenue therefrom represented a total of 3,314,355 vehicles with a revenue of $1,337,500. Toll revenues exclusive of revenue from traffic to the Exposition ground was $20,520,795.

EARLIER TOLL-FREE DATE

On September 16, 1940, in answer to a wide-spread public demand, the State of California took over State ownership and operation of the Carquinez and Antioch bridges and immediately put into effect a 30-cent toll per automobile and passengers. This rate represented approximately a 50 per cent cut in tolls that had prevailed prior to State acquisition of the two spans.

So successful has been State operation of these bridges that Director Clark believes if the present traffic prevails, a further reduction in tolls may be possible. When Mr. Clark recommended the purchase of the Carquinez and Antioch bridges, he assured Governor Olson and the other members of the Toll Bridge Authority that tolls could immediately be cut in half and that the two spans would be toll-free at an earlier date than would be possible under private ownership. The franchises of the American Toll Bridge Company, which owned the bridges, would have expired in 1948.

Traffic gains on the Carquinez bridge already have justified Director Clark's prediction in this regard. His prediction has not only been justified, but it now appears that the bridges can be made not only toll-free on or before the date on which the American Toll Bridge Company franchises would have expired but in the meantime, according to Mr. Clark, the motoring public will probably have the benefit of further toll reductions.

TRUCK TOLLS REDUCED

The California Toll Bridge Authority, acting for the people, acquired the two bridges at a net cost of only $5,593,000.

Since the date of purchase, operation has been so profitable that average toll charges for trucks on both spans have been reduced approximately 12 per cent.

On May 6th, the California Toll Bridge Authority adopted a new schedule of toll charges for trucks which went into effect on May 16th. Prior to that time, the average truck toll on the Carquinez bridge was $1.54. The new average toll is $1.36. The previous average toll on the Antioch span was $1.24, the new toll is $1.10.

The toll revisions apply only to trucks and are so arranged that the greatest benefits will accrue to the operators of the lighter trucks up to about 14 tons gross weight. The Toll Bridge Authority considered a rate reduction in the lower weight brackets to be quite consistent and equitable inasmuch as prior reclassifications gave preference to the reduction of tolls on the heavier vehicles.

ANTIOCH BRIDGE DIFFERENTIAL

The revised truck rates for Antioch Bridge are slightly less than those for Carquinez Bridge. This is in recognition of the fact that the predominant truck traffic on the Antioch Bridge is agricultural and does not have the high value of the more generally commercial and industrial traffic of the Carquinez span.

The new toll schedule effects an average reduction in truck tolls of about 12 per cent below the former rates. The total decrease in toll income as a result of these reductions will not be over 3 per cent. The reductions were fully justified by the present financial condition of the Carquinez and Antioch bridges.

The rates for trucks are based on a sliding scale according to weight, with a general lower rate for larger ton loads and a larger reduction in several of the smaller ton weight classifications. Trucks and trailers, including any load up to 6,000 pounds gross weight will pay 20 cents per ton as compared with the former rates of 30 cents on Carquinez and 27 cents on Antioch for gross weights up to 4,000 pounds.

NEW RATE SCHEDULE

Additional gross weights from 6,000 to 12,000 pounds pay 20 and 17½ cents per ton compared with former rates of 25 cents and 22½ cents. Similar differentiations are made for varying increased weights throughout the list, with a minimum charge of 40 cents on both structures.

Following is the new schedule of olls:

Class Vehicle	Rate Carquinez Bridge	Rate Antioch Bridge
. Automobiles, ambulances, hearses, taxis	$ 0.30	$ 0.30
'. Trailers drawn by automobiles	.25	.25
. Buses	1.00	.75
. Motorcycles	.15	.15
. Tricars	.20	.20
. Commutation—for passenger automobiles only. Book to contain from 50 to 54 one-way trip tickets (depending on length of calendar month), good for the calendar month	10.75	10.75
In addition the book will contain twenty (20) provisional tickets, each good for a one-way trip upon presentation and payment of twenty-five cents (25c), provided all regular tickets have been used. Additional provisional tickets for the same calendar month will be issued upon surrender of the complete empty cover—front and back—of a $10.75 commutation book of the same month.		
'. Trucks and truck trailers, including any load. Tolls calculated to the nearest multiple of five cents, in accordance with the following rates:		
Gross weight up to 6,000 lb., per ton, at	.20	.20
Additional gross weight from 6,001 lb. to 12,000 lb., per ton, at	.20	.175
Additional gross weight from 12,001 lb. to 18,000 lb., per ton, at	.15	.125
Additional gross weight from 18,001 lb. to 24,000 lb., per ton, at	.10	.075
Additional gross weight from 24,001 lb. to 30,000 lb., per ton, at	.05	.025
Additional gross weight above 30,000 lb., per ton, at	.01	.01
Minimum charge	.40	.40
:. Vehicles requiring special permit—Gross weight, per ton	.20	.20
Minimum charge	1.00	1.00
Vehicles exceeding limits of special permit or which, through no fault of the Division of Highways, are not provided with a special permit, gross weight, per ton	.40	.40
Minimum charge	1.00	1.00
'. Vehicles not otherwise specified—Gross weight, per ton	.20	.20
Minimum charge	.40	.40

Student: Sir, are we supposed to do all the problems on the quiz?

Pro.: No, every other one is on there just to hold the paper together.

Counsel (to the police witness): "But if a man is on his hands and knees in the middle of the road, that does not prove he was drunk."

Policeman: "No, sir, it does not. But this one was trying to roll up the white line!"

George R. Winslow Retires After 29 Years in State Service

G. R. WINSLOW

AFTER twenty-nine years of service with the Division of Highways, George R. Winslow, Assistant Construction Engineer, retired on May 31st.

During all the years since he entered the field of engineering, Mr. Winslow has had only two idle weeks in a very busy life—one week in New York between jobs and one week spent in traveling from New York to California in 1912 to become associated with Austin B. Fletcher, who, in 1911, was chosen by Governor Hiram W. Johnson to head the first State Highway Department of California. Mr. Winslow's friends and colleagues feel that he has fully earned a long rest.

Executives of the Department of Public Works and the Division of Highways and fellow workers of Mr. Winslow tendered him a complimentary banquet at the Sutter Club in Sacramento on Saturday night, May 24th.

Old timers who attended the dinner included three men who were associates of Mr. Winslow in the early days of the formation of the Division of Highways. They are C. C. Carleton, first attorney for the Division and now chief attorney for the Department of Public Works; J. B. Woodson, who in 1912 was Division Engineer with headquarters in Fresno and who is now in headquarters of District IV, San Francisco, and F. G. Sommer, retired, who in 1912 was Division Engineer with headquarters in Willits.

Missing was Thomas A. Bedford, retired, who was Division Engineer at Redding in those pioneer days. Mr. Bedford wrote from Rochester, Minnesota, that he was recuperating from a gall bladder operation and expressed his deep regret at being unable to attend the dinner.

Three engineers who entered the service of the Division of Highways shortly after Mr. Winslow were present. They are T. E. Stanton, Materials and Research Engineer; R. H. Stalnaker, Equipment Engineer, both of Sacramento, and L. H. Gibson, District Highway Engineer of District V, San Luis Obispo.

Born in Boston, Mass., on May 6, 1871, Mr. Winslow attended the Boston and Somerville public schools and then went to the Massachusetts Institute of Technology. One of his Pilgrim ancestors had charge of the roads at Martha's Vineyard Island. His first engineering work was as rodman on the Boston metropolitan sewer system. Later he worked in the office of McClintock & Woodfall doing general engineering work.

In 1898 he went to work for the Massachusetts Highway Commission and computed the earth quantities for the first contract let by the department. In 1906 he was employed by New York State when road construction under that State's first highway bond issue was launched.

Mr. Winslow and Mr. Fletcher had been friends in Massachusetts and when the latter became State Highway Engineer of California he sent for Mr. Winslow, appointing him Office Engineer of the Division of Highways here. The two men worked out the details of the organization of the department. Mr. Winslow was soon elevated to the post of Assistant Highway Engineer.

In 1920, Mr. Winslow was appointed District Engineer of District III, then in Sacramento, served in that capacity for four years and then was appointed Maintenance Engineer. In 1929 he became Assistant Construction Engineer, the office he held until his retirement.

Gradation of Mineral Aggregates in Dense Graded Bituminous Mixtures

By F. N. HVEEM*

THE use of mineral aggregates and soils in engineering works presents many problems due to variations in these materials. While physical and chemical differences are important, and have been much investigated, this paper will be confined to a discussion of particle size distribution of the granulometric composition and its effect on the design of mixtures.

The need for sieve analyses and grading studies is rather self-evident and the procedures involved are familiar to most engineers. However, it may be of interest to outline briefly some of the factors which lead to a study of aggregate gradations in California and to comment on some of the trends and relationships which came to light.

Mixtures of bitumen and mineral aggregate have been used since ancient times and bituminous pavements are by no means new. However, from time to time the same old combinations of asphalt and mineral aggregate have a rebirth under a new name usually with a real or implied modification in some element or proportion. When the first oil mix road in California was built in 1926 it was generally regarded as something new and distinctly different from earlier types of bituminous pavements and attracted considerable attention because it appeared at a time when the need for low cost road surfacing was becoming acute. Today this type of surface covers many miles of rural highways.

MANY DETAILED STUDIES

Wide-spread use of the oil mix type of surfacing has not been free from trouble and our present knowledge of the process has resulted from a great deal of study and research on the part of numerous highway departments. In common with other States, California is more or less continually investigating and attempting to improve design methods and testing procedures in order to assure satisfactory construction.

Since the first report by McKesson and Frickstad in 1927, detailed studies have been under way including among other things, an investigation of the possible influence of aggregate gradation. In 1929 there were a number of oil mix sections already in use ranging from good to poor. The main idea at that time was to find out why certain sections were behaving well and why others were showing considerable distress despite the fact that they had been constructed under the same specifications and apparently under the same conditions. We were well equipped for the study with a full quota of preconceived opinions and ingrained notions among which was the belief that the principles of aggregate gradation had been well expounded and we were more or less prepared to find that many of the troubles on oil mix roads could be accounted for by improper grading of the aggregate. However, when a series of samples taken from good and bad sections were analyzed, it was a little disturbing to discover that some of the most unconventional and irregular grading curves were identified with the most successful roads, while in several failures, the gradings complied very nicely with orthodox ideas as represented by Fuller's curve.

DISCOVERY UPSETS THEORIES

This discovery was something of a shock and tended to destroy faith in "well known principles." We could not escape the conclusion that a satisfactory bituminous surface could be constructed almost without regard to aggregate gradations if the bitumen content was adjusted for the particular aggregate and gradation. It was evident that this optimum bitumen content had no consistent relationship to the void volume except that it was always less than the amount required to fill the voids. Against this conclusion was the fact that virtually all construction men are concerned with "good grading" and with "poor grading" and even though it was evident that the "principles of grading" must be quite elastic, the possibility still existed that there might be an "ideal grading." Therefore, the first step was to compare gradings of various mixtures for the purpose of discovering any common properties or similarities which might exist.

In order to cover as broad a field as possible, portland cement concrete gradings were included in the study as well as gradings of bituminous mixtures. As these gradings covered a wide range of sizes, it was necessary to prepare grading charts which would permit comparison on a relative scale. This brought up the question as to the type of chart and the scales to be used.

FULLER'S CURVE

Figure No. 1 shows a simple linear scale on which Fuller's curve has been drawn. Fuller's curve as you know, has the form of an ellipse on the finer portion of the curve and has been projected either as a curve or straight line from the vertical axis of the ellipse to the upper right hand corner of the chart. The linear scale for the sieve sizes is not very satisfactory because the lines in the sand sizes are too crowded for definition. A better type of chart is the semilogarithmic type shown on Figure No. 2. The abscissa value or the screen sizes on the logarithmic chart give good definition throughout the entire range. Fuller's curve is shown transferred to the semilogarithmic chart.

The following figures, No. 3 to 9, will show the results obtained by platting the grading curves of previously existing construction which for the most part, represents gradings that resulted from long study or experimentation on the part of several individuals responsible.

* *Senior Physical Testing Engineer, Materials and Research Department, California Division of Highways.*

Fig 1

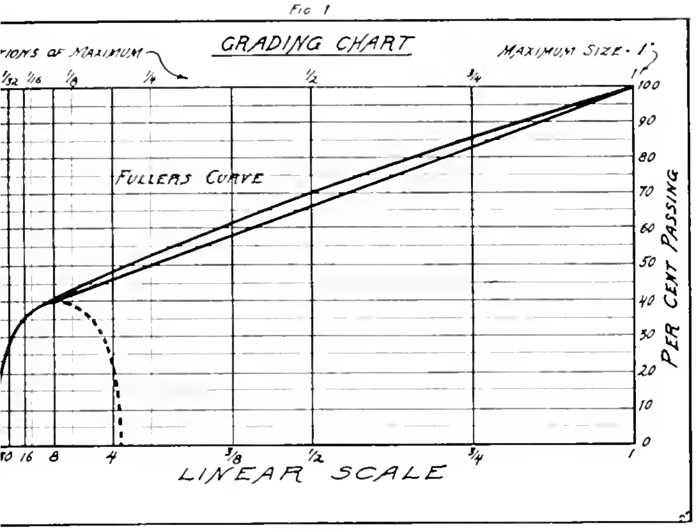


Fig 2

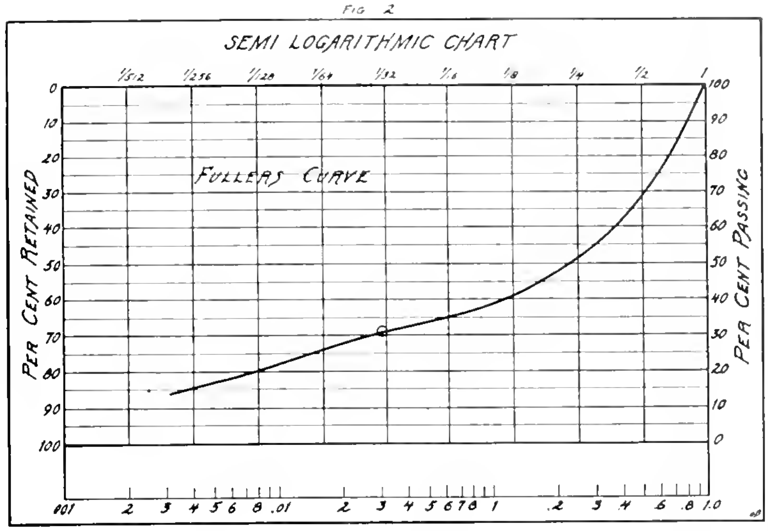


Fig 3

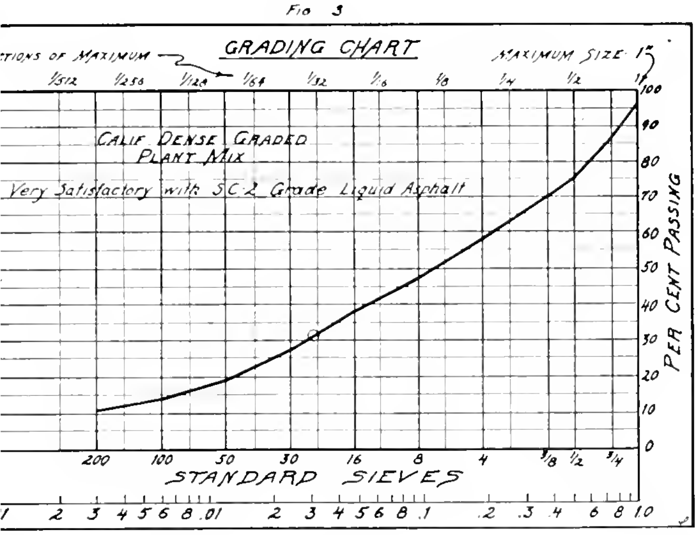


Fig 4

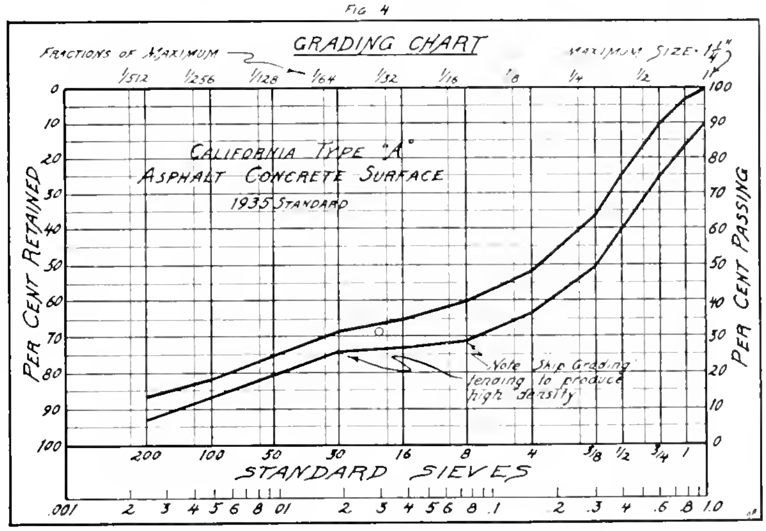


Fig 5

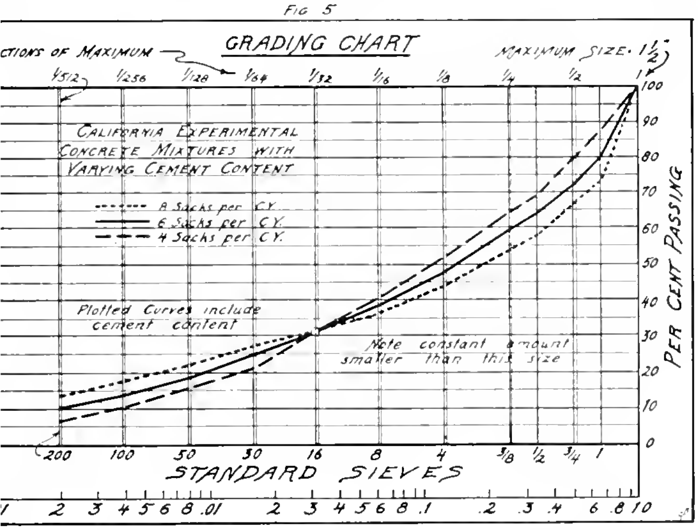


Fig 6

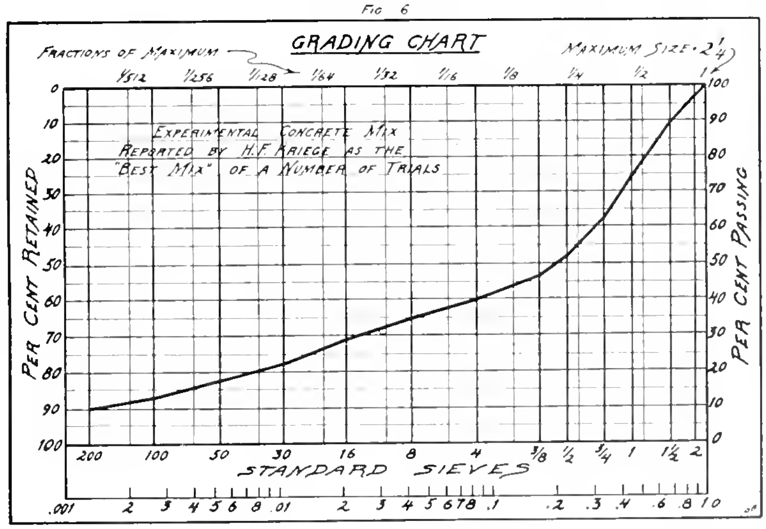


Figure No. 3 shows the grading of a plant mix surfacing in California from one of the most satisfactory jobs constructed prior to 1930. All material is smaller than 1 inch.

Figure No. 4 is Type "A" Asphaltic Concrete surface used in California for a number of years past. Material passes 1¼ inches.

Figure No. 5 is a series of three gradations of portland cement concrete using aggregate below ½ inch, with three percentages of cement. The three mixes were part of a laboratory experiment aimed at securing similar workability and water cement ratios with the varying cement contents. It should be noted that for comparison portland cement concrete mixtures are platted with the cement content included with the aggregate. You will note that the three gradations developed experimentally tend to intersect at a point represented by 31 per cent of the vertical scale and at a size equal to .031 on the abscissa scale. This point will be referred to later.

Figure No. 6 represents a grading of portland cement concrete developed by Professor H. F. Kriege and reported in Rock Products. All aggregate was smaller than 2¼ inches maximum.

Figure No. 7 is the "best grading" developed in our own laboratory for Portland cement concrete with a certain type of crushed rock at 2½ inches maximum.

Figure No. 8 is paving concrete with 3½ inches maximum stone and Figure No. 9 is paving concrete using 1 inches maximum stone.

DIFFERENT EXPERIMENTS

I would again like to repeat that all of these gradations were developed by different individuals working independently and separated by considerable distance and time, and each one represents the most ideal combination which was developed after a great many trials and consideration of other combinations. These figures by no means represent all of the material studied. Each is somewhat typical of the particular size group. **In passing I might call attention to the fact that regardless of individual variations in coarse and fine aggregate all of these most satisfactory gradings tend to pass close to the point represented by the co-ordinates, 31 per cent of the material passing a size equal to .031 of the particular maximum size of the gradation.** This prevailing common type or pattern of grading seems to be too consistent to be accidental and has been used to establish grading charts which have been made the basis for the design of bituminous paving mixtures. These charts shown herewith, indicate tolerance limits which are, in effect, a rationalization of data similar to that just shown.

Figure No. 10 is a so-called general grading chart showing the slope of the curve from maximum to minimum with the abscissa values drawn as relative sizes only.

Figure No. 11 is the same type of curve on which the abscissa values represent actual sieves as they would appear for a grading ranging from 1 inch to dust. Having thus arrived at smooth attractive looking curves, through the simple expedient of ignoring those cases which did not conform, it may be well to offer some explanation which would help to show why this uniform type of grading will often be more satisfactory than other curves.

MAXIMUM DENSITY

Figure No. 12 is a collection of aggregate gradings which have been proposed, tried, or, in some cases, used with considerable success. I would like to point out the heavy shaded line which, from Professor Kriege's report may be taken as the ultimate in maximum density. Professor Kriege stated that if 50 per cent of the coarsest size was combined with 50 per cent of the finest material, the **resulting density would be greater than that of any other combination of sizes within the maximum and minimum limits.** It appears then, that any virtue in the type of grading shown on Figure No. 11, is due to the avoidance of certain difficulties more or less inherent in other patterns of gradation. These liabilities or hazards are set forth on the figure in the form of brief notes indicating possible or probable results should the grading curve go beyond the tolerance limits in the area of the chart covered by the notation. However, these notations are an over simplification. For example, on Figure No. 13 the hypothetical grading shown is deficient in fine sand. A grading of this type will ordinarily be porous and may or may not be undesirable depending on local conditions.

Figure No. 14 shows a distinctly different type of grading which is caused by an excessive amount of sand between the 30 and 100 mesh size. This type of curve is typical of a mixture containing wind blown sand. Our experience has shown that such mixtures are usually low in stability and are often permeable as well.

IDEAL GRADING

As a result of this study it was possible to assign a few reasons why a grading curve should have some particular or peculiar characteristics. It appears that there are a number of factors which may be affected by the gradation and also several **which are not.** It is necessary for the designer to distinguish and isolate the separate individual items and properties which are needed to accomplish the purposes of a particular project. It is also **necessary to know which of the essential properties depend on and are affected by the aggregate gradation.** With this information and knowledge, it is possible to develop an ideal grading for a specific purpose and from that to determine how nearly the ideal grading can be achieved with the aggregate available. Thus, the basic requirements and conditions can be stated rather briefly but it is not always a simple matter to arrive at a practical solution because in practice, the best grading that can be secured is usually a compromise.

As the word "compromise" implies recognition and allowance for the demands of several diverse elements, it is now necessary to describe some of the factors which may affect the choice of gradings. One of the first and desirable properties of mixtures are the qualities of plasticity and mobility which are usually grouped under the heading of workability. Hydraulic concrete, bituminous mixtures, and stabilized soils all must be workable; the degree required **depends on the conditions of use and type of equipment.**

WORKABILITY IMPORTANT

Workability is usually of greater importance in portland cement concrete than in bituminous mixtures, nevertheless, it is one common requirement which is affected by gradation.

Another property influenced by grading is permeability. The importance of this property depends almost entirely on the type of structure. (A distinction should be made between permeability and density. The terms are not synonymous.) In paving mixtures it may be important that they be tight and relatively impermeable under conditions where it is necessary that a vulnerable subgrade be protected from the entrance of surface water through the pavement. It is often true, however, that the greatest danger of subgrade saturation comes from capillary moisture and a tight paving surface which restricts evaporation will frequently promote failure through an accumulation of moisture in a plastic subgrade. It has been demonstrated that a surface mixture with the proper degree of porosity will permit the subgrade to main-

Fig 7

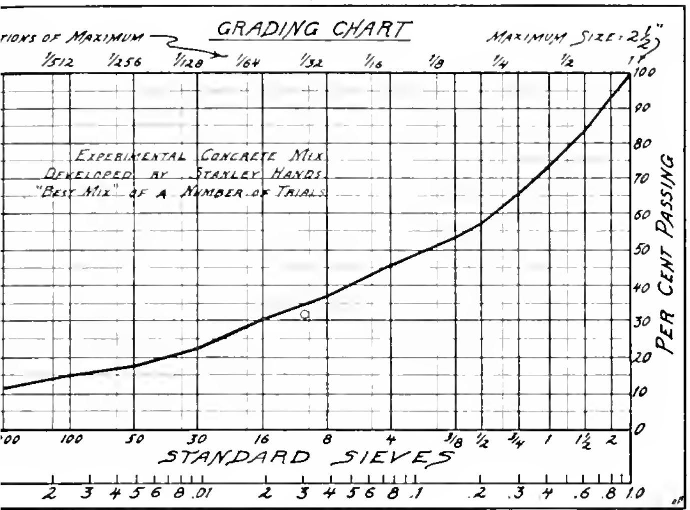


Fig 8

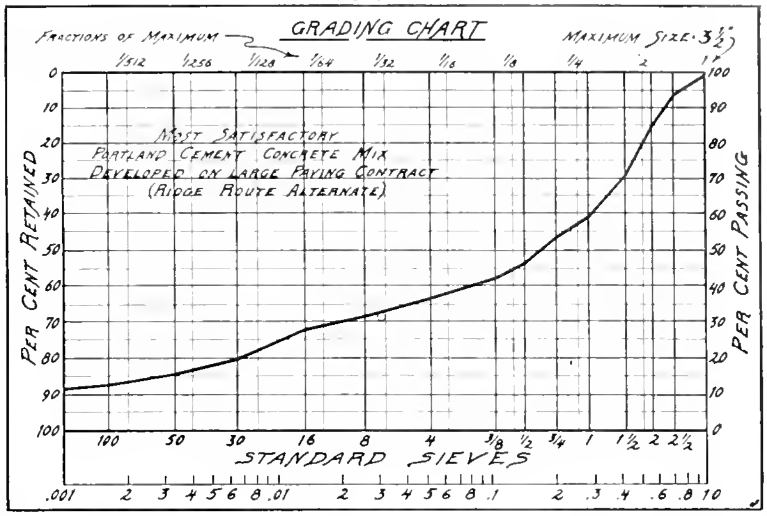
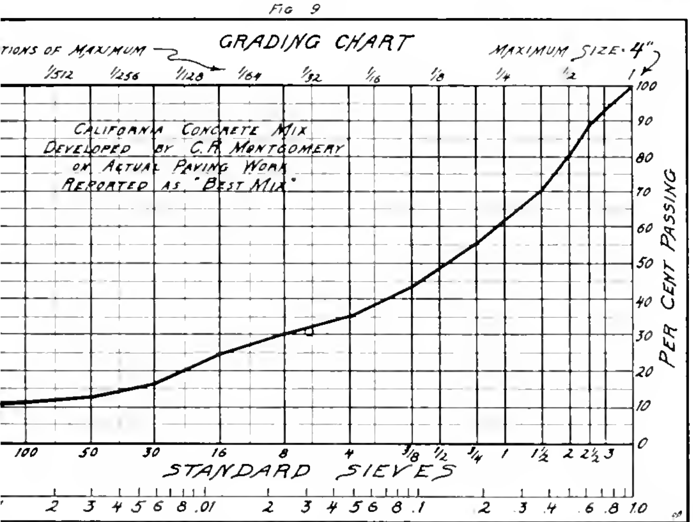


Fig 9



STATE OF CALIFORNIA — Fig 10 — DIVISION OF HIGHWAYS — MATERIALS & RESEARCH DEPT.

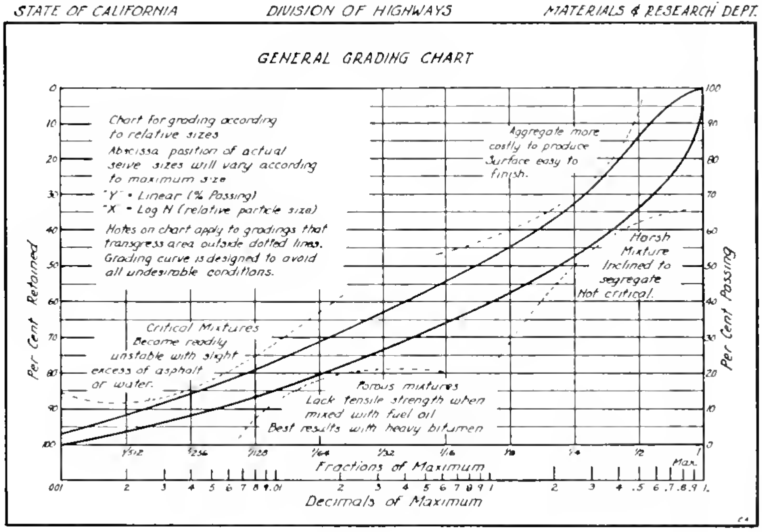


Fig 11 — STATE OF CALIFORNIA — DIVISION OF HIGHWAYS — MATERIALS & RESEARCH DEPT.

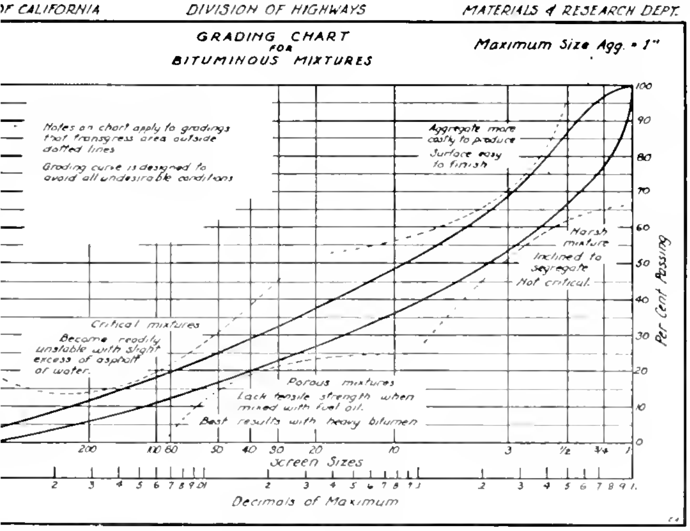
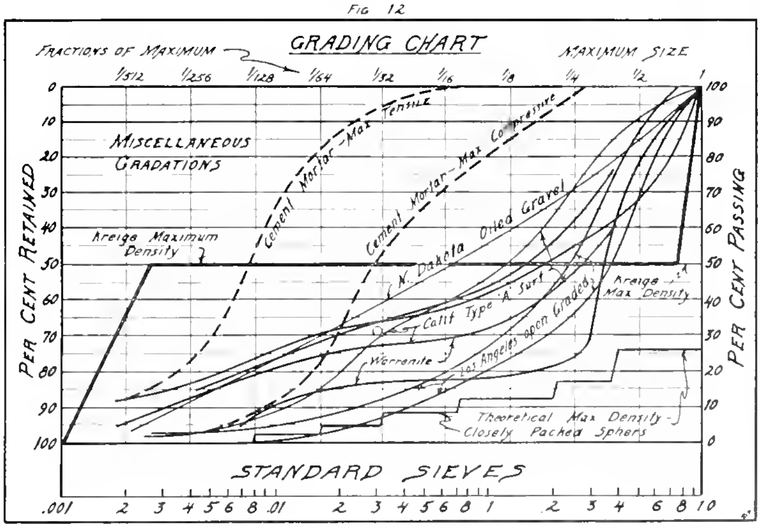


Fig 12



in a stable equilibrium by allowing moisture to evaporate rapidly enough to prevent excessive concentration. So far as is known, the design of paving mixtures has not often been deliberately adjusted to provide the necessary permeability. It is hereby suggested that it is a possibility well worth consideration.

Economy is a factor which may at times influence the choice of gradings but its importance varies with the particular conditions. Durability is important for virtually all structures but is not usually affected by the gradation of aggregate. Surface texture is a property peculiarly important to pavement construction and the present widespread interest in traffic safety makes skidding resistance an essential property, and the texture is inevitably influenced by the grading of the aggregate. Important properties which are only slightly or indirectly effected by aggregate gradation are the compressive strength of portland cement concrete and the stability of bituminous mixtures.

A great deal of discussion has appeared in technical literature concerning the significance of the voids ratio. So far as the writer has been able to determine, there is little evidence to show that the voids ratio can be dependably utilized in the design of mixtures. Neither the amount of binder required nor the important properties can be confidently predicted from a knowledge of the void volume alone. As stated by someone, while a packing box full of baseballs and one filled with peas will have virtually the same void volume, the number of points of contact and the superficial area will vary inversely with the particle diameters.

DESIGN OF ALL MIXTURES

In conclusion it may be pointed out, that mineral aggregates are possessed of one inherent property which affects the design of all mixtures regardless of the type of binder used. This property is described as internal friction of the granular mass implying that all solid particles offer resistance to sliding depending on their surface texture and pressure with which they are held in contact.

The equilibrium characteristics of the mass depend on the conditions which pertain at the points of contact between the discrete particles. A void has little if any character and particles do not transmit their influence across void spaces—only at points of contact. The stability of bituminous mixtures is largely dependent on maintaining a high value of internal friction, while on the other hand, the strength of portland cement concrete depends on the water cement ratio. This ratio can be maintained at its lowest value when the internal friction of the aggregate is inherently low, therefore the design of portland cement concrete tends to encourage the use of finer sands and smooth particles which in combination with water, promote mobility. In bituminous mixtures, the tendency should be towards the use of rough stone and a reduction of fine mobile material to the lowest amount possible in order to maintain high internal friction. However, as the stability of bituminous mixtures is also influenced by the cohesion any reduction in the amount of fines tends to reduce the cohesion values as well as to increase the permeability, thus we are around the circle and back to the need for con promise.

BEST GRADING

The best grading for any partic lar mixture can only be that whic utilizes the available aggregates t give as many of the desired prope ties as may be possible. For this re: son standardization of aggregat gradings can easily be carried too fa and as utilization of aggregates primarily a local problem due ca should be exercised in the adoptio of national standards for materia which are strictly speaking, not ma ufactured and which vary throughou the country. Commercial aggregate are not often shipped long distance and there seems to be no good reaso for requiring that crushed stone, san or gravel, in one region should mee gradations found satisfactory fc materials at some distant point.

As an example of the manner i which gradings can be slightly mod fied to secure less critical mixture figure No. 15 shows for compariso the asphaltic concrete grading use in California for a number of year past and the dotted line shows th modification which will be used i the future. The two gradings hav virtually the same amount of san finer than 10-mesh, however, th gradation of both fine and coars material has been altered. Thi change in grading tends to reduc the density of the combination an will provide a mixture which is les critical.

STABILOMETER VALUES

Figure No. 16 shows comparativ stabilometer values of the old and ne type of grading. You will note tha with a bitumen content of 5.6 stabilo meter values are virtually identica However, with a slight increase i asphalt, the older more dense mixtur tends to lose stability rapidly wherea the modified gradation will show sat isfactory stability up to about 6 pe cent of asphalt and in no case fall as low as the older type.

The lower chart shows variations i density with the two types. With 5. per cent of asphalt, the new gradatio has nearly 2 per cent greater voi volume and in this connection a larg number of studies have indicated tha when the relative specific gravity i higher than 97 per cent, virtually al asphaltic mixtures tend to lose stabil ity. Sufficient void space must b provided for the necessary amount o

In Memoriam

Samuel A. Cobb

Samuel A. Cobb, Associate Highway Engineer in the Department of Public Works, Division of Highways, District V, San Luis Obispo, California, succumbed to a heart attack May 27, 1941, while on official duty at Salinas.

Mr. Cobb was born near Tyler, Texas, January 2, 1879, and was a graduate of Texas A & M College.

His earlier activities covered engineering work for railroad and public services in the Texas Panhandle district and Oregon. From 1919 to 1925 Mr. Cobb served the State of Washington as Highway Locating Engineer.

He entered State service for California in March, 1928, as locating engineer in District VI at Fresno. In December, 1931 he transferred to District V at San Luis Obispo and for several succeeding years had the distinguished duties of resident engineer on the southern section of the Carmel-San Simeon Highway, a portion of the Roosevelt highway. During the past two years he was Safety Engineer for District V and succumbed while making traffic studies in the vicinity of Salinas.

His varied career, character and timely advice won him a host of friends throughout the west.

He is survived by his wife, brother and four daughters.

His fellow workers feel deeply his untimely passing and share sympathy with his bereaved family for the loss of a man who was held in high esteem by all who knew him.

Fig 13

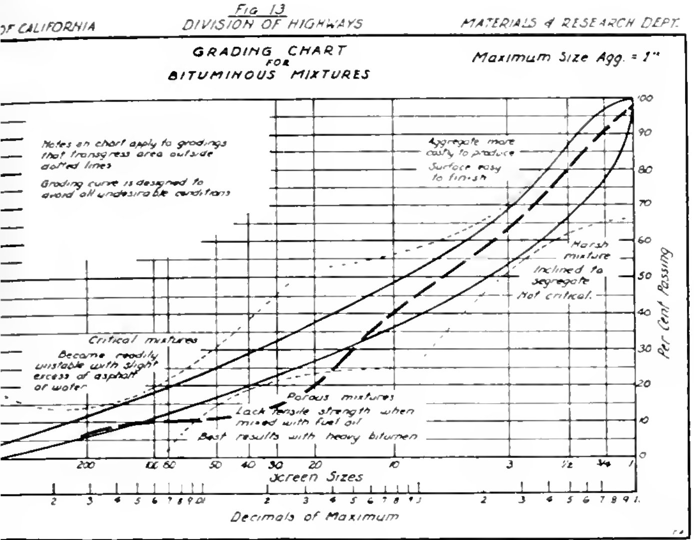


Fig 14

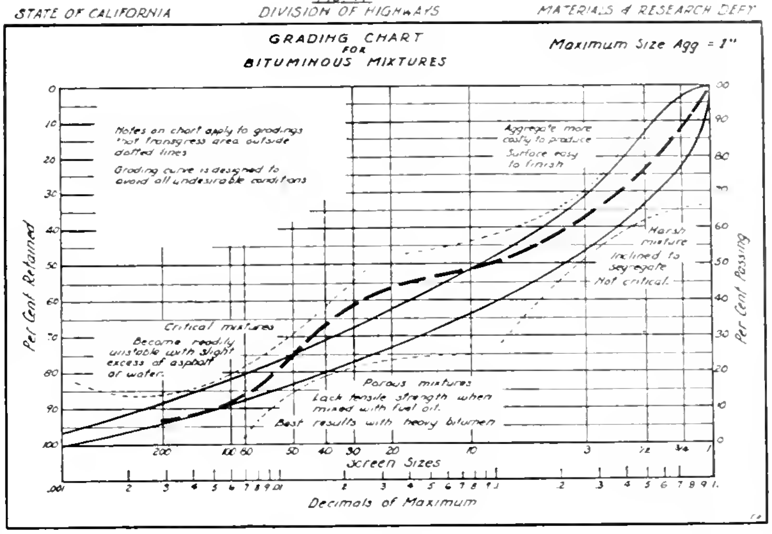


Fig 15

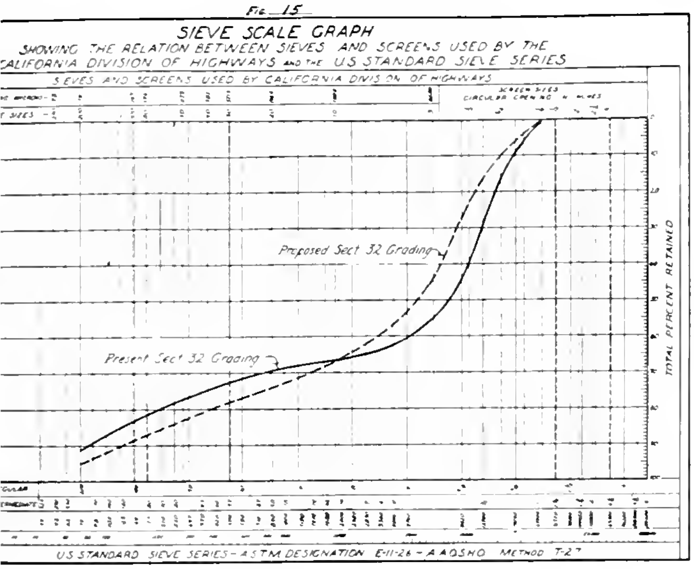
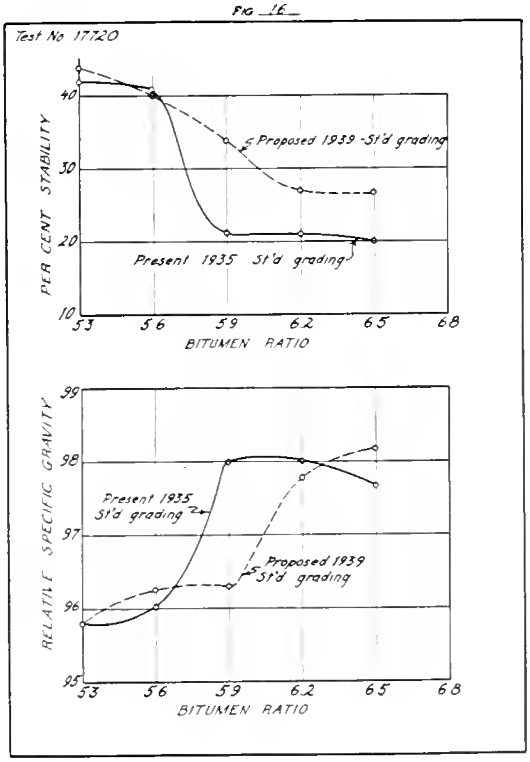


Fig 16



sphalt and the new type of grading ias been found to be more accomnodating and less critical than the lder type.

In conclusion, it can be repeated hat the best gradation is that which est suits the particular purpose and naterial available and, to borrow a hrase from Mr. T. C. Powers, "**A vide variety of gradings can be used ut we can not tolerate much variaion.**"

Madera-Friant Project

(Continued from page 4)

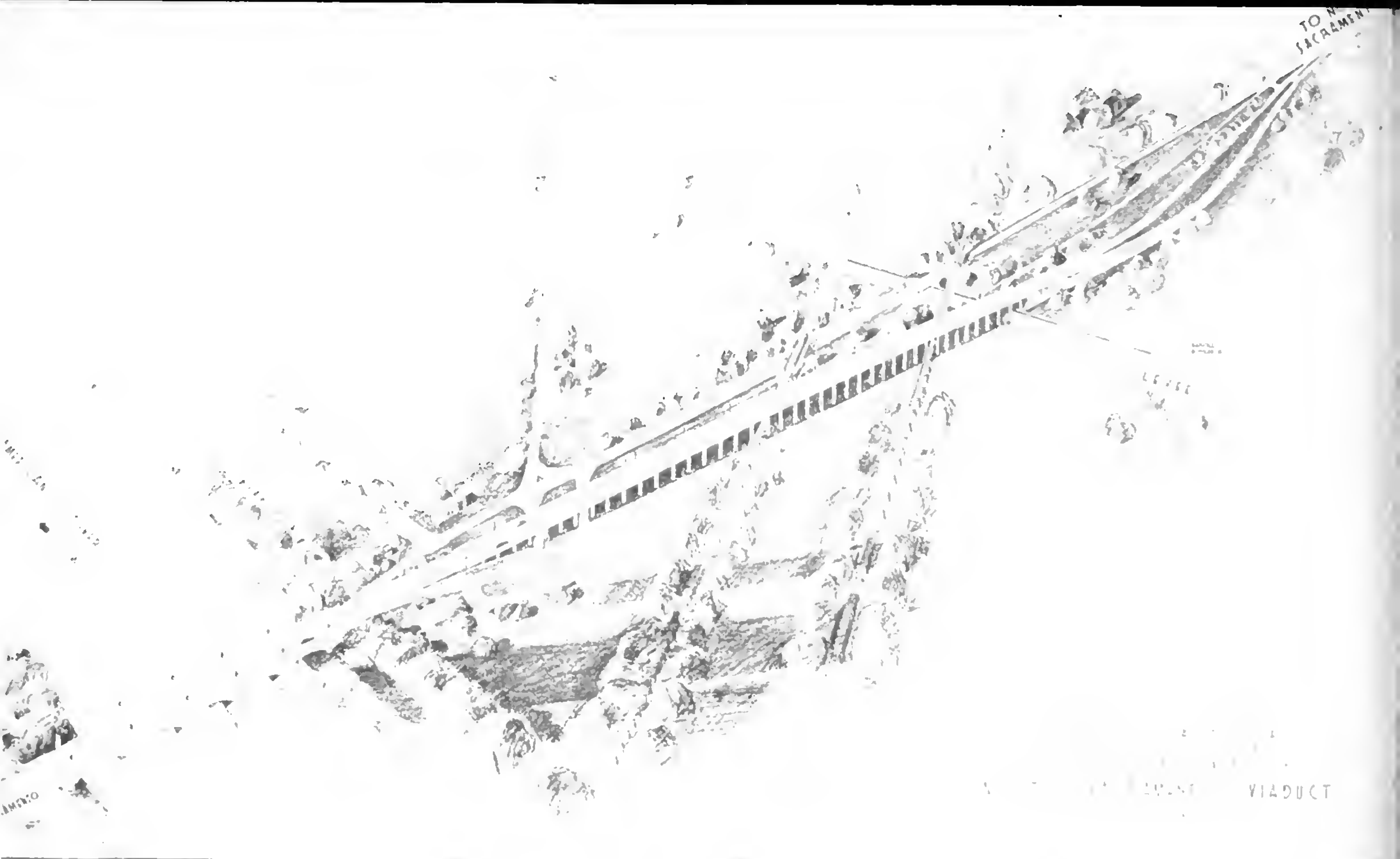
ractors, motor graders, carryalls and other equipment, the rental value of which was nearly $12,000.

Grading equipment varied from wheelbarrows to eight cubic yard carryalls. When the haul (or push) was too great for the wheelbarrows in some instances, strings of dump wagons, five in a row, hooked together by a long chain, were loaded by hand, and were hauled out to dump by a small tractor, while another string of five was being loaded.

Another similar means of hand excavation and loading was employed to comply with WPA regulation. A truck equipped with a special hoist was used to pick up, haul, dump and return six 2-cubic-yard dump boxes. The boxes were spotted where desired and loaded by hand. It kept the hoist truck busy supplying empty boxes for the workmen.

The dump wagon and 2-cubic-yard-box method of excavation proved much more interesting to the hand shovelers than did the wheelbarrows and the output was increased considerably. The men worked unusually hard to get the wagons or boxes loaded before the tractor or truck got back with the empties. In turn, the tractor operator and truck driver hurried to get the empties back.

A little over a year has been required to complete the project as originally planned. The result has been the construction of over six miles of wide roadbed with a 22-foot oil treated surface and a fine 142-foot reinforced concrete bridge.



Artist's sketch of proposed viaduct over American River overflow area on U. S. 99 between Sacramento and North Sacramento

Viaduct to North Sacramento

By R. W. HUTCHINSON, Associate Bridge Engineer

BIDS WERE scheduled for opening on June 18th for the construction of the North Sacramento Viaduct across the American River overflow area between Sacramento and North Sacramento. If an acceptable bid is received, work should start on the project about July 1st.

Approximately one year will be required to complete the structure and approach work. This will be welcome news to the people of the Sacramento area for whom the past wet winter and the activities at the Sacramento Air Depot have emphasized the necessity for a dependable route across the overflow channel.

The proposed project will make a true all year highway north on Route U. S. 99 and east on Route U. S. 40, as well as between the two cities which it will connect. The existing road has been intermittently closed by high water during the winter for an average of eight days per season for the past five years. On these days traffic must be detoured over narrow levee roads which add three miles and at least one-half hour to the trip between the two cities. The inconvenience has to be endured by the 20,000 to 25,000 cars which daily use this highway.

This stretch of road has been no less a tribulation to the highway maintenance forces than to the traveling public. Each period of high water meant a long vigil with sand bags to keep the road open as long as possible, patroling of detour roads and finally the cleaning up of mud and debris after the waters had subsided.

The new structure will start abou 300 feet north of the American Rive bridge and will rise on easy vertica curves at a maximum rate of 6.2 pe cent to a height of more than 50 fee above ground. It will clear the rai road trestles by 28 feet to provide fo future raising of the tracks which ar now below the extreme flood plane es tablished by the State Reclamatio Board Engineers.

Connections will be made at th end of the American River bridg and at the south limits of North Sac ramento. An off-ramp connectio will be made to the Garden Highwa and bottom lands passing under th structure so that cars will not have t cross opposing traffic.

At the south end of the structur where construction will interfer with traffic on the existing highway a detour will be provided which will ultimately be used as a permanent connection to the bottom land roads.

The viaduct will provide four traffic lanes on two 25-foot roadways separated by a four-foot dividing strip and in addition, two sidewalks each four feet wide. An open type steel railing will permit an unobstructed view from the deck and will harmonize with the structural features of the viaduct. The deck will be lighted by 20 incandescent luminairs.

The viaduct will be of reinforced concrete with the exception of the steel railing and expansion details. It will be 1,496 feet long consisting of 36 spans each 41 feet long with 10-foot cantilever spans at each end of the bridge. The bridge deck will have an overall width of 65 feet consisting of a six and one-half inch slab supported on 11 shallow girders each one foot wide.

The depth of the superstructure will be only 3 feet 8 inches, which was an important consideration in clearing the railroads with a minimum rise. The deck will be supported on bents consisting of a cap four feet wide and two columns each three feet square. The underside of the girders and cap will be kept on a plane to improve the appearance of the structure from the access roads which pass beneath it.

The use of two column bents proved economical for the the unusual height required in this type of construction and will permit the railroad tracks to enter through one span, pass diagonally between the bent columns and emerge through the adjacent span. This will eliminate the necessity of expensive skewed construction at the railroad crossings. Except at the railroad structures, where special footings are required to avoid interference, the bent columns will be carried on shallow footings just below ground level. Each column footing will be supported by nine concrete piles.

Expansion and contraction is provided for at eight joints. At the deck a sliding steel plate covers the required open joint. Structural loads are carried across the joint by a steel hanger rocking on steel pins to permit longitudinal motion. These joints are located at maximum intervals of five spans, or 205 feet, so as to keep at a low value the bending stresses due to temperature and thus permit more efficient use of the columns in carrying other stresses. The expansion joints are located seven feet from the bents so as to maintain continuous spans throughout.

Special attention was given the architecture of the structure because of the prominence which it will have when raised high above the flat river bottom. The dimensions of the deck and supporting columns were chosen so as to reduce the apparent bulk as much as possible.

An effort was made in design to procure similarity of details throughout the structure so as to obtain economy and speed in construction through the multiple use of forms and equipment. The repetition of details will enable the contractor to carry on the work in the most efficient order without the risk that portions of the work may be delayed by special materials not at hand.

Plans for approach roads were prepared by District III under the direction of C. H. Whitmore, District Engineer, and plans for the structure were prepared by the Bridge Department under the direction of F. W. Panhorst, Bridge Engineer.

DIFFICULT MATTER TO JUDGE EXACT SPEED

To ascertain the reliability of eye-witnesses' estimates of the speed of a motor car, the Royal Automobile Club of Sweden carried out carefully some 21,000 tests made with people of all descriptions, including persons who claimed to be experts. Not more than 18 per cent of those tested were able to place the speed of a passing motor vehicle within 5 per cent of the correct figure. More than half were as much as 20 per cent and more out in their estimates.

People who, because of special experience, might be expected to gauge fairly accurately were no better than others, and in some cases even worse. The tests were held under varied conditions. Trials were made in town and country, in daytime and at night; the cars were driven past in different gears, and attempts were made to produce all the conditions which might be present at accidents and collisions.

Orleans Bridge Wins First Prize in National Design Competition

(Continued from page 2)

The bridge has a reinforced concrete slab floor on longitudinal steel stringers. The floor beams are framed into a 30-inch, 108-pound wide flanged stiffening girder. These girders were fabricated as chords of the dead load camber curve and were fully spliced at 36-foot lengths.

Splices were placed about three feet from a floor beam or suspender connection to facilitate erection. Stiffening girders were completely assembled in the shop to their dead load camber position and all splices were reamed for rivets in this position. The splices were not riveted until the concrete slab had been poured and the bridge had taken its dead load deflection.

The steel towers contribute a great deal to the appearance of the structure and consist of two columns braced by elliptically shaped cross braces forming an arch over the roadway. The hinges at the tower bases rest on welded structural steel shoes.

Construction began in November, 1939, and was completed in September, 1940. The bridge was designed by the State of California and built under contract. C. H. Purcell is State Highway Engineer and F. W. Panhorst Bridge Engineer. C. W. Caletti and Company, San Rafael, was the general contractor, H. H. Gilbert the designer, and C. C. Winter the Resident Engineer for the State.

Replacement Program

Our present improved roads will not remain so without constant maintenance and replacement when they get beyond the condition of economical maintenance, or so obsolete that they are a menace to safe highway transport. The highway system very rapidly would decrease in adequately improved mileage if construction should stop. On the basis of road life studies made in connection with the state-wide planning surveys, if we were to eliminate future construction and reconstruction, by 1960 there would be only 27,000 miles of surfaced roads remaining from approximately 209,800 surfaced miles now in the Federal-aid system.

—*Highway Facts*

New Highway to Link Santa Ana and Coast at Corona Del Mar

By H. J. FALLAI, Assistant District Office Engineer

IT WAS the year 1769. A strange cavalcade, two brown-frocked padres and 61 soldiers of Spain with lances flashing in the sun, waited on the east bank of the Santa Ana River while axmen slashed a trail through the thick woods. After two hours of this work, a bearded officer ordered camp made for the night. It was Gaspar de Portola and his weary band cutting California's first trail.

It is the year 1941. Old trails have become old roads and old roads have become modern highways, in whose irregular network Los Angeles is linked to Portola's camp ground near Olive in Orange County and Olive is connected with Santa Ana and the sea. A new thread is being added to this network by the award of a contract on January 13, 1941, to Mittry Brothers Construction Company, of Los Angeles, for the extension of South Main Street, Santa Ana, at an estimated cost of $208,853.93.

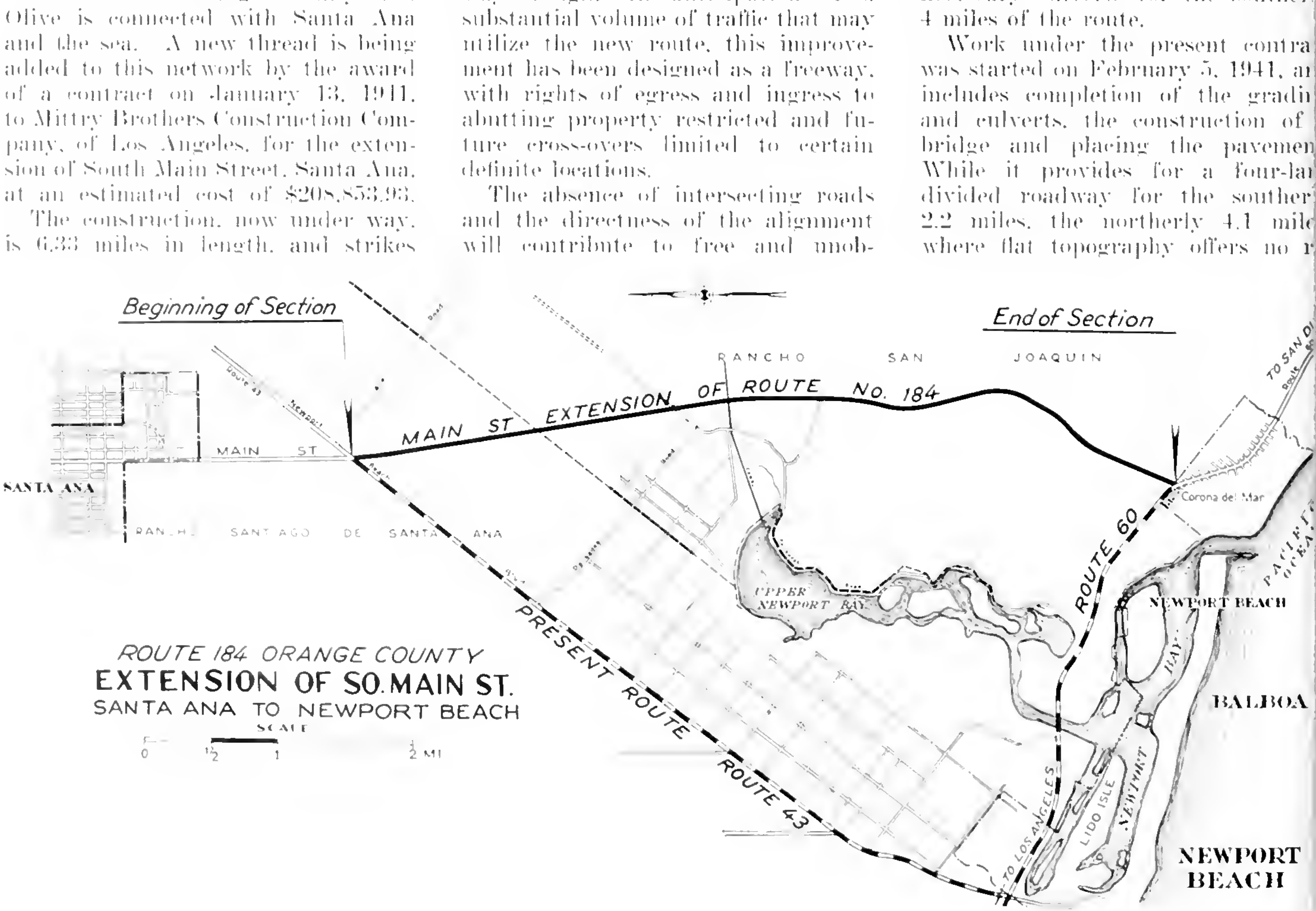
The construction, now under way, is 6.33 miles in length, and strikes due south to the sea from the intersection of Main Street and Newport Beach Boulevard at Santa Ana to Corona Del Mar. Heretofore, traffic flowing from the interior via Santa Ana to beach communities along the South Orange County coast has had to follow Newport Beach Boulevard. The new route offers a saving to the traveling public of 3.3 miles, or approximately half the length of the new improvement.

With the constantly increasing volume of traffic in the metropolitan area adjacent to Los Angeles, the planning of important new highways has necessitated the adoption of freeway design. In anticipation of a substantial volume of traffic that may utilize the new route, this improvement has been designed as a freeway, with rights of egress and ingress to abutting property restricted and future cross-overs limited to certain definite locations.

The absence of intersecting roads and the directness of the alignment will contribute to free and unobstructed travel. In order to redu hazards the project has been designe for two lanes of pavement on ea side of a median strip separati opposing traffic streams. The sout erly 2.2 miles, where hilly terra prevails, include a 6-foot dividi strip on a roadbed 66 feet wide. T northerly 4 miles lie mostly in fl country and provision is made for future 20-foot center strip, with roadbed 80 feet wide.

This project was initiated in 19 by Orange County as a relief proje The county's share of the work co sisted of the construction of a grad roadbed and the installation of t necessary culverts for the souther 4 miles of the route.

Work under the present contra was started on February 5, 1941, a includes completion of the gradi and culverts, the construction of bridge and placing the pavemen While it provides for a four-la divided roadway for the souther 2.2 miles, the northerly 4.1 mil where flat topography offers no r



rictions to sight distance, will be he conventional two-lane road. This, owever, is stage construction and, s soon as funds are available, the our-lane divided highway will be ealized for the full length of the job.

On this improvement, the question f type of pavement or surfacing was he occasion of considerable study. nasmuch as limited funds did not ermit the placing of the conventional type of heavy pavement, some heaper type had to be developed. aboratory investigation indicated hat within the project area suitable oil was available for cement stabiliation.

As a result of these studies, a ypical roadway section was evolved, onsisting of a blanket of selected aterial ranging from 7 to 10 inches ompacted depth, topped by 8 inches f cement treated soil base, and 3 nches of plant-mixed surfacing. This ype of construction promises a surace that will withstand a subtantial volume of traffic at a cost ess than that of the usual types of eavy pavement.

Construction of the cement treated ase will consist of scarifying and horoughly cultivating the uppermost 3 inches of selected soil, followed by he addition of Portland cement in a niform application varying from 6 o 8 per cent by weight of dry soil. The soil and cement will be thoroughly mixed and the necessary water dded until a uniform mixture reults. The mixture will then be haped and rolled to yield a compacted base 8 inches in thickness as he subgrade for the plant-mixed surfacing.

A forecast of future traffic which may utilize the new extension was estimated from traffic counts taken at various intersections in the vicinity of the new improvement. From analysis of this data it was concluded that the minimum traffic expectancy approximated 1,510 vehicles for a 16-hour week-day, while the maximum expectancy totaled some 3,340 vehicles per day.

It is probable that the estimate of 3,340 vehicles does not indicate the full extent of travel which may be expected. In the light of past experience in this area, there is reasonable assurance that highway improvements such as this develop more traffic than is indicated by traffic movement observations taken prior to the completion of the work.

(Continued on page 24)

Construction Scenes on Santa Ana-Corona del Mar Highway Link. Top—Culvert Construction near Santa Ana. Center—Graded route at Corona del Mar end. Bottom—Junction point with Coast Highway

Bids and Awards for May, 1941

CALAVERAS COUNTY Between San Andreas and Angels Camp, about 3.4 miles to be graded and surfaced with plant mixed surfacing on a base of untreated rock surfacing. District X, Route 65, Sections A,B,Ang. Hemstreet & Bell, Marysville, $151,728. Contract awarded to Claude C. Wood, Lodi, $128,084.

LASSEN COUNTY Between Constantia and Route 21, about 12.1 miles to be surfaced with plant-mixed surfacing. District II, Route 29, Section E. A. Teichert & Son, Inc., Sacramento, $57,680; Hemstreet & Bell, Marysville, $57,860; Piazza & Huntley, San Jose, $65,600; Isbell Construction Co., Reno, Nev., $68,920; J. A. Casson, Hayward, $70,840; Marshall S. Hanrahan, Redwood City, $81,700. Contract awarded to Fredericksen & Westbrook, Sacramento, $56,120.

LASSEN COUNTY Between Viewland and Madeline, about 18.1 miles to be surfaced with road-mixed surfacing and shoulders to be constructed. District II, Route 73, Sections B,E,F. Fredericksen & Westbrook, Sacramento, $53,166; J. C. Compton, McMinnville, Ore., $58,584; Lee J. Immel, Berkeley, $58,684; Oranges Bros. Construction Dept., Stockton, $62,151. Contract awarded to Harms Bros.-Powers & Patterson, Sacramento, $44,199.

MARIN COUNTY Between Myrtle Avenue in San Rafael and San Quentin Wye, about 1.3 miles in length, Portland cement concrete pavement, curbs, gutters and sidewalks to be constructed. Plant mixed surfacing to be constructed on crusher run base, and penetration treatment to be applied to shoulders. District IV, Route 1, Sections S,Rf. Lee J. Immel, Berkeley, $20,387; Chas. L. Harney, San Francisco, $21,529. Contract awarded to A. G. Raisch, San Francisco, $19,743.

MENDOCINO COUNTY—Across the South Fork of Eel River, about 65 miles north of Willits, a bridge to be redecked. District I, Route 1, Section K. Louis Biasotti & Son, Stockton, $14,692; A. Soda & Son, Oakland, $13,220; C. C. Gildersleeve, Berkeley, $11,996; Mercer Fraser Co., Eureka, $12,151; E. E. Smith, El Cerrito, $14,938. Contract awarded to A. O. Lightford, Upper Lake, $8,790.

ORANGE COUNTY—A bridge across the Santa Ana River, about four miles south of Yorba Linda, to be repaired. District VII, Route 175, Section B. J. S. Metzger & Son, Los Angeles, $23,298; The Contracting Engineers Co., Los Angeles, $24,335; J. E. Haddock, Ltd., Pasadena, $25,543. Contract awarded to J. E. Burrell & Sons, Long Beach, $19,155.

PLUMAS COUNTY Between North Fork and Keddie, about 19.9 miles to be surfaced with plant mixed surfacing on imported borrow on a portion of the project and over existing pavement on the remainder of the project. District II, Route 21, Sections B,C. A. Teichert & Son, Inc., Sacramento, $153,112. Contract awarded to Hemstreet & Bell, Marysville, $143,442.

PLUMAS COUNTY Between Beckwourth and Edes Ranch, about 9.3 miles to be surfaced with plant mixed surfacing and shoulders to be constructed. District II, Route 21, Section G. J. A. Casson, Hayward, $47,000; Fredericksen & Westbrook, Sacramento, $47,990; A. Teichert & Son, Inc., Sacramento, $50,690; Isbell Construction Co., Reno, Nev., $55,175; Jones & King, Hayward, $55,830; Piazza & Huntley, San Jose, $56,145; Hemstreet & Bell, Marysville, $56,315; Claude C. Wood, Lodi, $58,672. Contract awarded to Poulos & McEwen, Sacramento, $44,147.

SANTA CLARA COUNTY—Area at El Camino Real Underpass in Palo Alto to be landscaped and an irrigation system to be installed. District IV, Route 2, Sections A,P.A. West Coast Nursery Co., Palo Alto, $8,732. Contract awarded to Leonard Coates Nurseries, Inc., San Jose, $8,227.

SAN LUIS OBISPO-SANTA BARBARA COUNTIES At points between 40 and 67 miles east of Santa Maria, a bridge across Carrizo Canyon to be constructed and two bridges across Cuyama River to be redecked. District V, Route 57, Sections B,C,D. The Contracting Engineers Co., Los Angeles, $52,390. Contract awarded to T. C. Tunsen, Modesto, $39,998.

Boy Scouts Do Good Deed On Flooded Road

Four members of Boy Scout Troop 16 of Fellows, California, had an opportunity to do their good deed for the day on March 3d when they assisted maintenance men of the Division of Highways in Kern County to handle traffic on a debris-clogged road. The Scouts—Eugene Colfax, Milton Scott, Bill Beard and Ray Wright—were commended for their work in the following letter sent to each of them by District Highway Engineer E. T. Scott of Fresno:

It was with sincere appreciation that this office received the information from our Maintenance Superintendent, Mr. M. L. Cardwell of Taft, that during and following the storm of March 3, 1941, particularly between the hours of 8.00 p.m. and 9.00 p.m. you, in company with three other members of Boy Scout Troop 16 of Fellows, voluntarily removed debris consisting of lumber and limbs washed on to the traveled way of the State Highway and flagged traffic operators with a lantern, warning them of dangerous conditions ahead.

Please accept the thanks and commendation of this Department of the State for this action on your part which displayed a spirit admired by everyone.

A copy of this letter is being forwarded to our Central Office.

Yours very truly,

E. T. SCOTT,
District Engineer.

New Highway to Link Santa Ana and Coast

(Continued from page 23)

It is certain that some of the traff which normally flows along the in land route between Santa Ana an San Clemente will be attracted to th new route. No attempt has been mad to forecast the peak traffic that ma be expected on Sundays and holiday when large numbers of people ar attracted from the interior to beac communities along the Orange Count coast. It is possible this peak ma reach 10,000 vehicles per day.

It is not often that a project afford a saving in distance of approximatel half the length of the improvemen Just as important is the money save to the traveling public by such shor ening. This is a major consideratio in evaluating the economic justifica tion of a project.

In this connection it is possible t evaluate the saving in distanc Adopting as a conservative base th minimum traffic expectancy of 1,51 vehicles per day, traffic may be ex panded into a yearly count of 622,00 vehicles. With a saving in distanc of 3.3 miles and a conservative opera tion cost per vehicle of 3 cents pe mile, the yearly saving in operatin costs by the public will total approxi mately $62,000. This means that a automobile traveling the new rout once a day for one year would net saving to the individual driver of little over $10 per year.

Progress of the work was retarde by the unprecedented winter rain but, as this article goes to press, th contract is approximately 10 per cen complete, and work promises to be i full swing within a very short time

By March, 1942, a new road fron Santa Ana to Corona del Mar wil invite an eager quota of 622,00 vehicles and each vehicle will reap substantial saving in operating costs

---

Experience is not what happens to man. It is what a man does with wha happens to him.

Judge—Have you a lawyer, Sambo?
Sambo—Naw, suh, Jedge. We don decided to tell de troof.

State of California

CULBERT L. OLSON, Governor

Department of Public Works

Headquarters: Public Works Building Twelfth and N Streets Sacramento

FRANK W. CLARK, Director of Public Works

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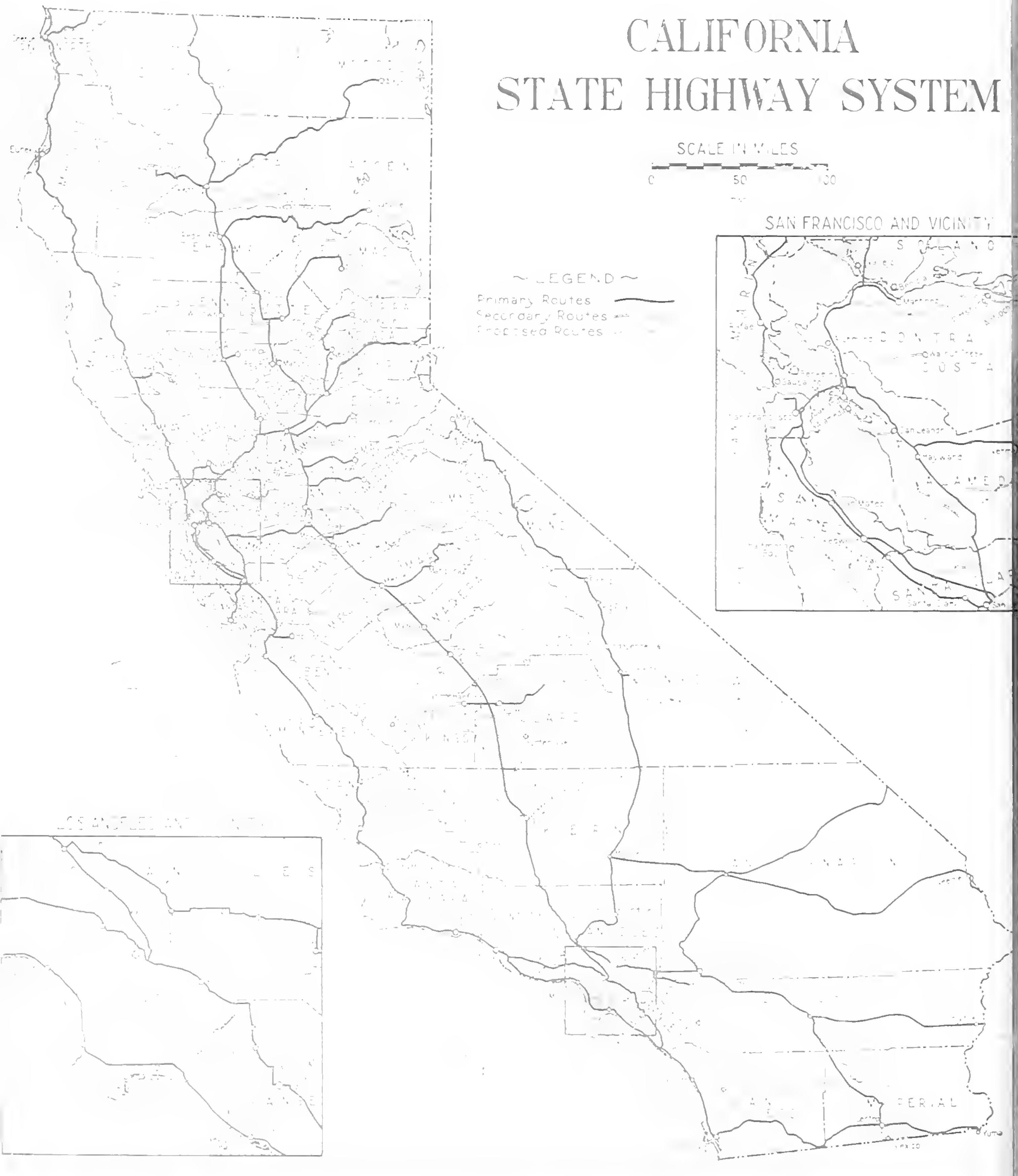

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

VIEW OF SECTION OF NEW TIOGA PASS HIGHWAY LOOKING WESTERLY FROM A POINT BETWEEN LAKE ELLERY IN MONO COUNTY AND THE TIOGA PASS EASTERLY ENTRANCE TO YOSEMITE VALLEY
(SEE ARTICLE IN THIS ISSUE)

JULY
1941

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CALIFORNIA STATE HIGHWAY SYSTEM

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(SEE ARTICLE IN THIS ISSUE)

JULY 1941

Slide Problem

STORMS DO COSTLY DAMAGE ON STATE HIGHWAYS YEARLY

By T. H. DENNIS, Maintenance Engineer and R. J. ALLAN, District Materials Engineer, District VII

THE removal of slides and repair of storm damage are major phases of State highway maintenance work. In the 10 years since 1931, expenditures of $13,780,000 or practically one-sixth of the total of $82,656,000 required for maintenance has been used for this purpose. Some 9,000 miles of the system are located in rugged or rolling country or in the flood channel of large streams, and includes the portion of the system on which such damage occurs. The travel on this mileage represents two-thirds of the total travel for the entire rural State Highway System. In many sections, the closing or even partial closing of the road presents an emergency situation.

Naturally, the amount of expenditure from maintenance funds varies from year to year, depending on the severity of the particular season. This is shown by comparison of the proportion of total funds required for such work as indicated below:

Year	Percentage of Expenditures for Major Slide and Storm Damage to Total Maintenance Expenditures
1931-32	12.65
1932-33	7.91
1933-34	9.55
1934-35	9.56
1935-36	16.27
1936-37	13.89
1937-38	36.21
1938-39	11.44
1939-40	19.44
1940-41	18.46
Ten-year average	16.37

The influence of extreme conditions is evident for the 1937-38 season.

SLIDE REMOVAL PROBLEM

In modern highway work, the problem of slide removal, correction of fill foundations and protection from storm damage is of major importance from the standpoint of construction, as well as the maintenance cost. On two major projects, (1) the American Canyon on State Highway Route 7 in Solano County, on which grading was completed in 1935, and (2) the Cuesta Grade improvement on State Highway Route 2 in San Luis Obispo County, completed in 1937-38, for example, the removal of slides represented approximately 12 per cent of the total cost. During the past 10 years more and more attention has been given to design of slopes and to corrective work during construction.

SALES TAX NOT VALID ON BORROW PIT MATERIAL

Under a ruling by the Attorney General, a sales tax is not payable on gravel or other excavated material used in highway construction and maintenance and purchased under the form of "borrow pit agreement" used by Division of Highways.

In the past, property holders who have disposed of such material have been assessed a sales tax based on the amount of money paid to them by the Division of Highways or its contractors and have added the tax to the price charged for the material.

In the opinion of the Attorney General, which has been accepted by the State Board of Equalization, transfer of gravel, dirt, rock or other excavated material under a written instrument wherein the State is "granted * * * the right of easement and privilege to enter upon * * * land and excavate and remove * * * materials, if and when and as needed by the State and in any amount or amounts up to and not exceeding the maximum amount specified as the State may deem necessary" does not constitute a sale of tangible personal property and, therefore, no sales tax is payable.

The opinion is in accordance with views heretofore held by attorneys for the Division of Highways.

Construction which involves cuts of 100 feet or more in depth, and fills of 50 feet or more in height, is certain to disturb the surface balance which nature has achieved over hundreds of years. Likewise the area of slopes subject to wash and weather is greatly increased for such work as compared to earlier designs. Equipment and methods for ascertaining subsurface conditions and materials have been developed, and more attention is being given constantly to the matter of design of slopes in cuts and of foundation for fills on all new construction projects. Even with the best equipment available, however, only limited information can be secured as to probable future developments once a grading project is completed.

SLIDES ARE EMERGENCIES

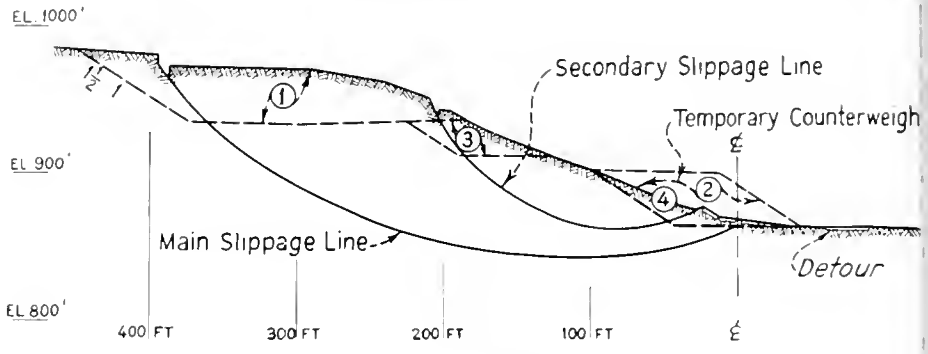
For through routes, particularly where the daily traffic averages from 10,000 to 20,000 or more vehicles, the partial or complete closing of the road by slides or slipouts becomes an emergency. This has been evidenced on the Bay Shore route when the road has been partially closed at Brisbane slide at times, and on Waldo approach to Golden Gate Bridge, which is closed for short periods once or twice each season. Roads available for detours at these two locations are inadequate, and confusion results immediately when the traffic flow is interrupted.

In the case of the Waldo approach, a special study was made of the slopes on completion of the regular grading work while the contractor's equipment was on the job, and some 300,000 cubic yards of additional material was removed, with the result that interference to traffic has been kept to a minimum on this important section. The present policy recognizes this advantage to traffic in planning slope and protective work as part of construction.

ON RURAL SYSTEM

For the rural State Highway System as a whole, charges for major slide removal or storm damage were made against 6,765 miles of road for the 1938-39 Winter season, and 6,896

These pictures show volume and force developed by a circular type slide, such as occurred at Kellogg Hills



ORDER OF WORK

1. *Excavate upper bench*
2. *Build temporary counterweight*
3. *Excavate secondary bench*
4. *Remove counterweight*

SECTION THROUGH KELLOGG SLIDE
ON U. S. HIGHWAY 70—WEST OF POMONA

miles for the 1939-40 season. In an extreme storm, two-thirds of the daily traffic on the entire system would be endangered or inconvenienced in some degree. From the traffic as well as cost of maintenance points of view, it is very desirable that the most thorough job of slide removal and protection work be carried out at the time of construction. From a strictly economic viewpoint, however, extreme measures may be difficult to justify. The final stabilization of a road may require years in time and necessarily involve heavy maintenance expenditures.

In general, landslides are of the following types:

1. **Slides due to weathering or erosion.**

   These may consist of broken masses of rock or earth, or of soil or silt washed from the face of a cut into the side ditches or onto the pavement, sometimes to a depth of several feet.
2. **Slippage along defined planes which become lubricated by rain or springs.**
3. **Crushing of the underlying formations, which are not strong enough to withstand the load when the support is removed in excavating the road prism.**

FILL SLIPOUTS

Slipouts refer, in general, to movement of fill material and may be due either to movement of the natural ground as a result of the fill load, or movement of material in the fill, which becomes saturated to the point where it flows under the existing load.

Stabilization of the face of cut slopes against ordinary erosion is a somewhat expensive process. The most desirable method is the establishment of natural vegetative cover. However, this requires fertile soil and soil moisture, and is not generally effective where slopes are steeper than 1½ to 1, since the imported soil will wash away. Some success has been had by construction of terraces or digging holes in which fertile soil could be placed for support of plantings. For sandy soils, paving or oiling of slopes has been carried out in particular cases and, for mud flows, bridges have been constructed to carry the material under the roadway.

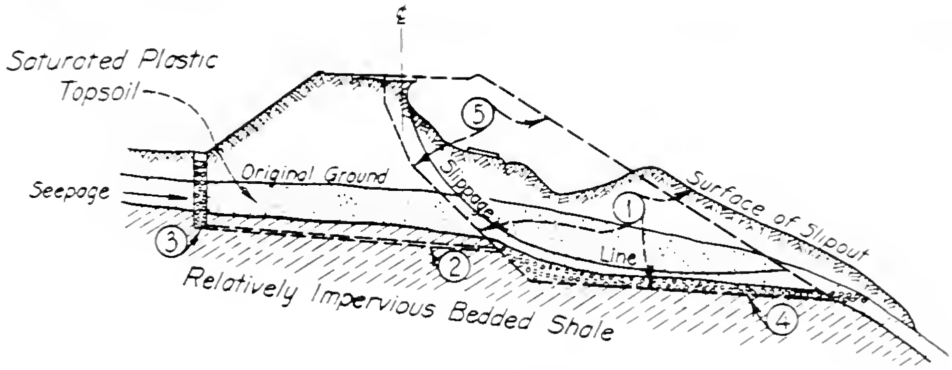
Weathering of cut slopes goes on continually, and slides from this cause may occur years after the original construction, even though all loose material had apparently been removed.

All slides are failures due to insufficient frictional resistance of the soil to resist the driving force caused by its weight. They are usually caused by excess moisture in the soi which not only increases its weigh but also decreases its cohesiv strength. Hydrostatic pressure de veloped by underground water ma also contribute to the cause of eart failures.

Although every slide or slipou must be studied as an individua case, certain general principles o investigation and correction ar usually applied. The study usuall consists of a boring investigation in some cases supplemented by a geo logical study, to determine the typ of slide, the location of the slidin surface, and the presence of under ground water.

Where a definite source of underground water can be located, provision should be made for intercepting the water and removing it from the slide area. In many cases, however, no definite source of moisture can be found, saturation having taken place by a more or less uniform percolation

Views of slipout on Ridge Route Alternate, U. S. 99. Sketch shows method of correction



ORDER OF WORK

1. *Remove slide material*
2. *Place perforated pipe in boring*
3. *Construct intercepting trench*
4. *Construct gravel subdrain*
5. *Rebuild fill*

SECTION OF SLIPOUT
SHOWING METHOD OF CORRECTION

f surface waters. It is always adisable to look for shallow ponds or prings above the slide area and to rain any that may be found. In ny case, diversion ditches should e constructed to keep surface water ut of the slide cracks which have eveloped.

CIRCULAR TYPE SLIDES

In the correction of the circular ype of slides, the forces acting upon ne circular slide surface are first nalyzed. Benches are then excaated in such a manner as to reduce ne driving force as much as possible ithout reducing more than necesary the forces which tend to inrease the friction on the sliding surace. This is usually accomplished y removing benches toward the pper portion of the sliding arc. 'his type of correction is illustrated n the accompanying sketch of the Cellogg slide. If the angle of inernal friction and the cohesion of he soil can be determined by test nethods, a reasonably accurate nathematical analysis of such slides nay be made to determine the mount of material which must be emoved in order to stop the movenent. Where these properties of the oil can not be readily determined, hey may be estimated in order to nake an approximate analysis.

In the case of bedding plane or ault plane slides, the only possible orrective measures which can be pplied are the interception of unlerground water which may be ubricating the slide plane and the emoval of all of the loose material bove the plane. In many cases vhere the dip of the strata is relaively flat, this type of slide is progressive and enormous quantities of material must eventually be removed. In some extreme cases, it may even prove to be more economical to relocate a portion of the highway than to attempt the removal or correction of this type of slide.

SURFACE SOIL SLIDES

The correction of surface soil slides is similar to that which is applied to the bedding plane type.

Since most slipouts are caused by saturation of the foundation soil, it is obvious that drainage of the foundation is of major importance as a corrective measure. This is usually accomplished by the construction of a cut-off trench on the upper side of the fill to intercept the flow of underground water. An outlet for this trench is usually provided by means of a pipe installed through the fill, either by jacking the pipe, boring, or installing the pipe in a trench.

The slide material is excavated down to relatively dry impervious soil and either a gravel blanket placed or gravel and tile drains constructed in the foundation soil. After these drainage provisions have been completed, the fill is then reconstructed.

Where the topography is favorable, the waste material removed from the slipout may sometimes be used to advantage in the construction of a counterweight or bracing fill below the main fill.

This procedure is practicable only where the ground slope below the fill is relatively flat, or where the counterweight may be constructed across the bottom of the canyon to form a support against the opposite side. It is usually necessary to provide foundation subdrains under such counterweight fills, as well as under the main roadway fill.

(Continued on page 10)

Tioga Pass

HIGHWAY ENGINEERS ACHIEVE ANOTHE VICTORY OVER NATURE IN HIGH SIERR

By J. N. STANLEY, Resident Engineer

WITH two and one-half miles of its precipitous roadway widened and realigned to eliminate grade curves, historic Tioga Pass highway, blanketed with snow since early last fall, was opened to summer traffic on June 20th.

This most recent improvement of Tioga road between the easterly boundary of Yosemite National Park and Lake Ellery in Mono County was completed toward the end of last year at a cost of $78,600. The contractor started work on August 15, 1939, and finished the work on September 20, 1940, using well over a year to do a job that consisted principally of excavating less than 50,000 cubic yards of rock. However, in all of that time, the opposing elements of nature—tempestuous winds, snow storms and freezing temperatures—allowed the contractor only 165 working days and many of those were spent in drilling only, when snow was still too deep to permit full scale operations.

Tioga Pass highway is on State Sign Route 120, which after crossing the summit drops down the eastern slope of the Sierra Nevada range to Mono Lake and continues on to the Nevada State line near Tonopah. It forms the eastern entrance to Yosemite. At the summit it connects with the highways of the park system.

HIGH ELEVATION

The project recently completed is situated on the highest section of road in the State Highway System. Beginning in Tioga Pass at an elevation of 9,941 feet above sea level, it curves easily downward past meadow, brook and peak to Lake Ellery, an elevation of 9,500 feet.

In the vicinity of this pass are found some of the most beautiful and interesting spots in all California and the completion of the improvement is regarded locally as one of the high lights in the 80 years of man's struggle against the barrier of the Sierra at this crossing.

To the motorist passing through this region for the first time, there comes a feeling of pioneering. It is impossible to escape the impression that this area has just been opened to travel or to escape a sensation of newness and freshness. A maze of treeless peaks, whose slopes are mantled with spotless snow fields, surround the wayfarer. The stones along the way are as clean as a dining table and may be safely used as such. Crystal clea streams fed by the melting sno banks descend in foaming cataract The roadway seems to have bee carved from the primeval rock onl yesterday and the air seems freshe than any ever sensed before.

PIONEERS FACED PROBLEM

The impression of newness, how ever, arises, not from the fact tha man has not previously invaded thi territory, but from the fact that hi puny efforts have been of little ava against the obstacles set in his path b Nature. Alaskan winters that clos the pass from six to nine months o each year have kept him at arm length. The efficiency of man, beast and machine is so reduced by the ef fect of altitude that the most Hercu lean efforts, backed by careful plan ning and organization have left littl more than faint evidences of the pain taken through four-fifths of a century

The first pioneers to this regio were the inevitable prospectors. En tering by horseback from the west an from the east the hard way, afoot over the crags, their prying eyes an picks soon found reasons for staying

(Continued on page 6)

Section of new Tioga Pass Highway looking easterly toward Camp Tioga. Left—Before and (right) after improvement

Views on new Tioga Pass Highway. Upper—Vista of Tioga Lake. Center—Looking easterly from Yosemite Park checking station. Bottom—Entrance to Yosemite Valley.

Left—Section of old Tioga Pass road at Leevining Creek bridge. Right—Same section after improvement

(Continued from page 4)

The Sheepherder Mine was located in 1860, and a small town, Bennettville, soon sprang up. This settlement was later renamed Tioga, and was located about two miles northerly from the present road on sparkling Mine Creek. The hardy souls inhabiting the now long vanished community managed without a road for over 20 years, surviving in some manner on the meager supplies that could be brought in over dim and tortuous pack trails.

TOUGH JOB FOR MINERS

The miners were caught on the horns of a dilemma: they could not afford to build a road until the mines could be made to produce the large sums required for such an undertaking; and, without the roads, machinery needed to develop the mines could not be brought in. After many years of hesitation and attempting various schemes, a plan was evolved whereby they might bring in the mining equipment without a road. They decided to take advantage of the chief impediment to the development of the whole region, namely the snow and ice of the long cold winter.

A lusty and booming mining town named Lundy grew up with the sudden vigor characteristic of such settlements on the shore of nearby Lundy Lake. This camp was less than 10 miles from Tioga as the crow flies but a good 3,000 feet lower in elevation. Lundy was connected to the outside world by good wagon trails leading through the then metropolis of Aurora, Nevada. The much needed machinery was shipped to Lundy, in the summer time, and the Tioga miners settled down and waited for the arctic winter to freeze the mountain lakes into hard surfaced boulevards and for the deep snows to iron out minor irregularities of intervening talus slopes and boulder-choked gorges.

SLEDS HAULED OVER TIOGA

The winter that followed would seem to have been of a severity most pleasing to the furtherance of the transportation plan. From that winter's news in the Lundy Miners Index, edited and published by one "Lying Jim" Townsend, the following item, among others, has been preserved attesting to the gratifying depth of the snow:

"Our devil says that he doesn't mind carrying the paper around on snowshoes; that is great fun; but thinks his eyesight injured by smoke while calling down stove pipes and chimneys to people to look after their paper as he dropped it down."

When the snow was considered deep enough and the lakes frozen a foot thick, the goods destined for Tioga were loaded on especially prepared sledges and the moving job began. The heavy loads were towed slowly along by long ropes wound inch by inch onto capstans set up far ahead. When the capstans were reached they were dismantled and carried ahead another lap, and the ropes again attached and again wound slowly in. And so they proceeded, across the frozen lake, up the icy talus slopes, over cliffs rising hundreds of feet vertically. The loaded sledges broke through the snow again and again, wedging themselves crazily into draws and crevices, where they were painfully pried out by pole an crow-bar, or block and tackle snubbe to scrub juniper or drill steel ardu ously set into the rock where no tr grew. Every ounce of propulsive e fort was furnished by human muscl and when the task was done it ha cost three lives and many thousan of dollars.

ROAD BUILDING EXPENSIVE

Realizing that they could not affor to get rich by such transportatio methods, the miners decided to buil a road at any cost. In 1883, mone was raised in Sonora for a road lea ing down the west side to that plac Work was started at once, and a roa 14 feet wide was completed in 188 from Carl Inn to Tioga. No figur as to the cost are at hand but it understood that the road buildin exhausted the finances of all co cerned. Internecine strife then brok out among the stockholders and th mines languished through years c court action. The new road fell int disuse and neglect and became in passable until taken over by the Na tional Park Service many years late and developed into the sturdy moun tain highway now serving the west ern approach to the pass.

In the meantime another minin combination, known as the Grea Sierra Mining Company, came upo the scene and took over Tioga mines. The long trek out to Sonor was discarded as an economic impos sibility for their venture, so a muc shorter road was built eastward dow Leevining Canyon to the shippin and supply centers of the Mon Lake area. This road was little mor han a trail that clung most precariously to the gray granite walls of the reat abyss below Lake Ellery, although it was known as "The Great Sierra Wagon Road." Its cost reatly exceeded all expectations and pparently depleted the resources of ts builders as completely as had the oad previously built toward Sonora.

STATE TACKLES PROBLEM

The Great Sierra Company hung n and tried to maintain the road, nlisting the aid of Mono County, but uch funds that all interested paries were able to raise towards its naintenance and improvement were nsufficient. The workable summer eason seemed only long enough to lear away the previous winter's lides and then another winter was pon them, and another year had ed.

The California State Highway 'ommission became interested in the ossibilities of this route across the ierras and in August, 1914, a party f Commissioners attempted to inpect the road driving up the grade rom Mono Lake. Half way to the ummit, at "Blue Slide," progress vas barred by a fallen rock and the rip abandoned. Under the circumtances, it is small wonder that the 'ommission should have felt relucant to have the road taken into the tate system, particularly since the Great Sierra Company was asking 25,000 for its interest in the road.

In 1915, the situation took on a new omplexion. Public spirited Stephen '. Mather, one of the outstanding gures of all time in the National 'ark Service, purchased the road with his own and other donated private funds and turned it over to the public as a gift.

NOW MODERN HIGHWAY

The name "Great Sierra Wagon Road" is practically forgotten and can only be encountered in old records and the files of old newspapers. The route is now identified under the more descriptive title of "Tioga Pass Road." The State took over the road as a State highway many years ago and has gradually improved the entire length from Mono Lake to the summit. It has been widened throughout, and improvements continue year by year, shooting off a point here, building a wall there, providing safe and adequate bridges, all combining to produce a road of a quality far exceeding the wildest dreams of those dauntless men who braved the crags so long ago.

The little valley forming the eastern approach to the pass was carved from a solid block of hard rock by prehistoric glaciers which left dozens of little knolls and hillocks of solid rock, scattered without reference to pattern. These small ridges and humps consisted of the hardest knurls in the original rock mass, the type of rock that could, and did, stand up under the grinding of thousands of tons of ice made abrasive by included rock particles through a period of thousands of years. Scratches made on the surfaces of the rock masses by pebbles dragged across them in the grip of the grinding glaciers still show plainly, although winds and snows of some 50,000 years have sought to erase such evidence.

Most of the excavation on the project was encountered in cutting through these small hard-rock hills and, in spite of the fact that the contractor had equipped himself with the most modern equipment, his progress was slow in such material. Drilling was the major problem, as the rock was crystalline and broke up readily once the explosives were properly placed. Jackhammers scarcely dented the rock and were given up in favor of wagon drills except for use in plugging isolated boulders. Drill bits were used literally by the truck load, and a grinder was kept going steadily night and day. Water heads were installed and were comparatively successful, increasing the average hole drilled per bit from one inch to five inches. Cold weather prevented a complete change over to wet drills which could only be used when the temperature was above freezing.

The work was barely finished in 1940, and the road-mixed surfacing was laid out after the first fall of snow had already whitened the mountains.

The contract was performed by Isbell Construction Company, of Reno, Nevada.

TIOGA HIGHEST PASS IN STATE

Of 14 prominent mountain passes in California, Tioga is the highest with an elevation of 9,941 feet.

Sonora is 9,624; Ebbetts, 8,800; Carson, 8,650; Conway, 8,100; Echo, 7,365; and Donner, 7,135.

The other passes range from 4,315 to 6,350.

These are two more views of Tioga Pass Highway before and after realignment

Looking toward Davis from a point on realigned U. S. 40 Highway south of State Nursery

Improvement

NEW CONSTRUCTION PROGRESS ON U.S. 40 BETWEEN DAVIS AND DIXON

WORK is now under way on three projects between Dixon and Sacramento which are units in the development of this portion of U. S. Route 40 into a divided highway. This road is a part of the main east-west transcontinental highway terminating at the San Francisco Bay area and carries heavy traffic, both commercial and pleasure, throughout its entire length. Its development as a divided highway will enable it to serve the constantly increasing traffic with a greater degree of efficiency and safety.

Previous articles in "California Highways and Public Works" have discussed the contracts which provided for the grading and the construction of bridges and underpasses on new alignment between 1.3 miles north of Dixon and 1.0 mile east of the Davis Subway. A contract has just been awarded providing for the placing of Portland cement concrete pavement on both lanes of the highway from the South Fork of Putah Creek to 1.0 mile east of the Davis Subway and on the new south lane between Swingle and the Yolo Causeway.

Between 1.0 mile east of Davis Subway and the Yolo Causeway, the same contractor is completing work on two contracts. The first contract covers the grading and surfacing with Portland cement concrete pavement of the new south lane of a divided highway and the resurfacing with plant-mixed surfacing of the existing highway, which will serve as the north lane. The limits of this work are from 1.0 mile east of the Davis Subway to Swingle. The second contract provides for grading a new south lane between Swingle and the Yolo Causeway.

The soil in the vicinity of all these projects, while suitable for certain types of agriculture, is, in general, not particularly well adapted to use in road construction, since it usually has a low bearing value and fairly high swell. After considerable investigation, sources were located from which sandy or gravelly material could be obtained for use in the upper part of the roadbed, but it was necessary for reasons of economy to use the poorer soil in the lower portions. In order to insure a proper moisture content in this material and prevent

(Continued on page 17)

Views of realigned U. S. 40 between Davis and Dixon in Yolo County. Upper—Looking toward Yolo Causeway and Sacra-
ento from point near State Nursery, showing resurfacing material windrowed in center of old highway. Center—Looking toward
avis: State Nursery on left. Bottom—Fill and widening operations for divided highway at point directly south of Yolo Causeway

The upper three pictures show a slide in progress south of Topanga in Los Angeles County. Lower pictures show hazard and exte of typical slipouts. Sketch shows method of correction

Storms Do Costly Damage on Highways

(Continued from page 5)

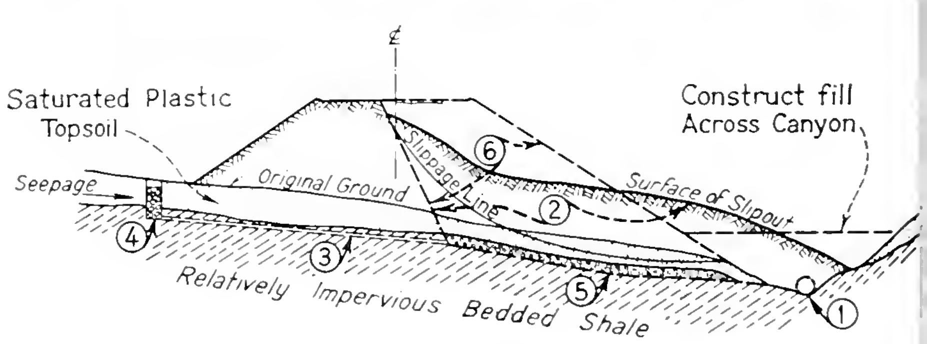
It will be readily seen that, before corrective designs for slipouts can be made intelligently, an investigation by means of borings to locate the saturated zones is absolutely necessary. Furthermore, great care must be taken during construction to verify the information disclosed by the borings and to be sure that the stripping operations are carried down to relatively dry and stable material, before the foundation drains are installed and the fill reconstructed.

Failure to remove all of the plastic soil, or to place the drains sufficiently deep before reconstructing the fill, may result in complete failure of the corrective measures and consequent loss of all of the work performed. For this reason, inadequate preliminary investigation or lack of inspection of the work during its progress, may prove to be very costly.

SATURATION

For several years past the rainfall in the Los Angeles area has been well in excess of the normal. During the past rainy season, for instance, an all-time record was established when the precipitation was more than double the normal amount. The cumulative effect of this series of excessively wet seasons is being shown in the large number of serious slides and slipouts which have occurred this year. In many instances, cuts and fills which had previously shown no indication of instability have failed because of the high degree of saturation which has been accumulating.

The Kellogg slide in located on Garvey Avenue (U. S. 70) near the Kellogg Ranch, a few miles west of Pomona, on a section originally completed in 1933.



ORDER OF WORK

1. *Place pipe in creek bed*
2. *Remove slide material*
3. *Place perforated pipe in boring*
4. *Construct intercepting trench*
5. *Construct gravel subdrains*
6. *Rebuild fill*

SECTION OF SLIPOUT
SHOWING METHOD OF CORRECTION

As may be seen from the accom panying diagram, this is a very goo example of the circular arc slide an serves well to illustrate the metho of correction applied to this typ It will be noted that this actuall consists of two slides, one within th other. The lower or secondary slid was the first to be noticed. Soo afterward the pavement started t bulge and the upper slide crack wa discovered. The movement was grad ual but during one period amounte to several feet a day and the pave ment was uplifted as much as 1

(Continued on page 23)

Supreme Court Upholds Authority of Public Works to Require Relocation of Pipe Line Placed in Highway Under State Franchise

By FRANK B. DURKEE, Attorney, Division of Contracts and Rights of Way

AUTHORITY of the Department of Public Works to require the owner of a pipe line to move the same, at the cost and expense of such owner, to a different location within the highway, "whenever necessary to insure the safety of the traveling public or to permit of the improvement of the highway," as provided by Section 680 of the Streets and Highways Code, has been upheld by the Supreme Court in the case of *State of California vs. Marin Municipal Water District*, decided April 2, 1941, and modified in certain particulars on May 1, 1941. (101 Pac. (2d) 112; 111 Pac. (2d) 651; 3 Cal. Dec. 52, 631.) The decision is now final.

The pipe line, subject of the litigation, was placed in what was previously a county highway of the County of Marin by the predecessor in interest of the defendant Water District pursuant to a permit granted by the Board of Supervisors in 1909. Upon establishment of the State Highway System, the highway in question was taken over and incorporated into the right of way of the State highway (Road IV-Mrn-1-C).

JUDGMENT FOR STATE

The section of pipe line required to be moved was located in an area which had been originally a mud flat along the shore of Richardson Bay. Building of the Waldo Approach to the Golden Gate Bridge required placing of a considerable fill over a portion of the area. Engineers of District IV were of the opinion that the fill would cause such a subsidence of the ground as would result in rupture of the pipe line, with consequent destruction of the fill and hazard to life and property.

A formal demand, in writing, as contemplated by the code, was served upon the water district directing it to relocate its pipe line from within the area within which the fill was to be made. The district declined to act, whereupon the department had the necessary work performed by the State's contractor. The action in the superior court was brought pursuant to Section 722 of the code to recover the amount paid the contractor under the extra work order.

Upon trial, it was shown that removal and relocation of the pipe line was necessary, not only to insure safety of the traveling public, but, also, to permit improvement of the highway. Judgment was for the State, and the water district appealed.

DISTRICT APPEALS

The defendant district contended that, under the language of Section 19 of the Municipal Water District Act, it had a grant from the State which gave it a vested right to occupy the highway with its pipe line; that to require it to assume the cost of relocating the main would violate constitutional provisions against the impairment of the obligation of contracts and the taking or damaging of property without due process of law; that, in any event, Section 680 of the Streets and Highways Code was not applicable to the situation, on the ground, among others, that a water district is a subdivision of the State.

In affirming the judgment, the Supreme Court held that the right of a district, organized under the Municipal Water District Act, to maintain water mains along a public highway must be considered a "franchise" (which was the position of the department), whether regarded as derived from the district's acquisition of the assets and property of the private corporation, its predecessor in interest, the act under which the district was organized (Stat. 1911, p. 1290), or the general provisions of the several statutes conferring upon municipalities the right to construct water mains along the highways. (Stat. 1911, p. 852; Stat. 1923, p. 147.)

In modifying its opinion, subsequent to filing of a petition for a rehearing, which was denied, the court specifically held that the defendant water district derived its "franchise" by virtue of its existence as a subdivision of the State from the Statutes of 1911 and 1923 granting to municipalities certain rights to occupy highways. These statutes, the court said, conferred upon the district the right to maintain a pipe line along the highways of the State only "in such manner as to afford security for life and property."

AUTHORITY GIVEN

Section 680 of the Streets and Highways Code, the court pointed out, gives the Department of Public Works the authority to require removal of a pipe line at the owner's expense when "necessary to insure the safety of the traveling public or to permit of the improvement of the highway."

"It is clear," the court went on to say, "that neither defendant nor any other municipal water district has the authority to maintain pipes on the highway in a position which does not afford security for life or property, and therefore that the application of Section 680 to municipal water districts would not result in a limitation upon their otherwise valid power, but would operate only to prevent them from exercising their franchises in a manner contrary to law."

In other words, the section in question is "clearly within that residuary power of the State * * * known as the 'police power'."

Further, the court held, relocation of defendant's pipe line would not deprive it of its franchise; "it has simply been required to bear the expense of removing its mains to a location on the highway consonant with public welfare. The benefit to the public as a whole * * * clearly outweighs the burden imposed upon defendant, and the legislation (Section 680) is therefore valid."

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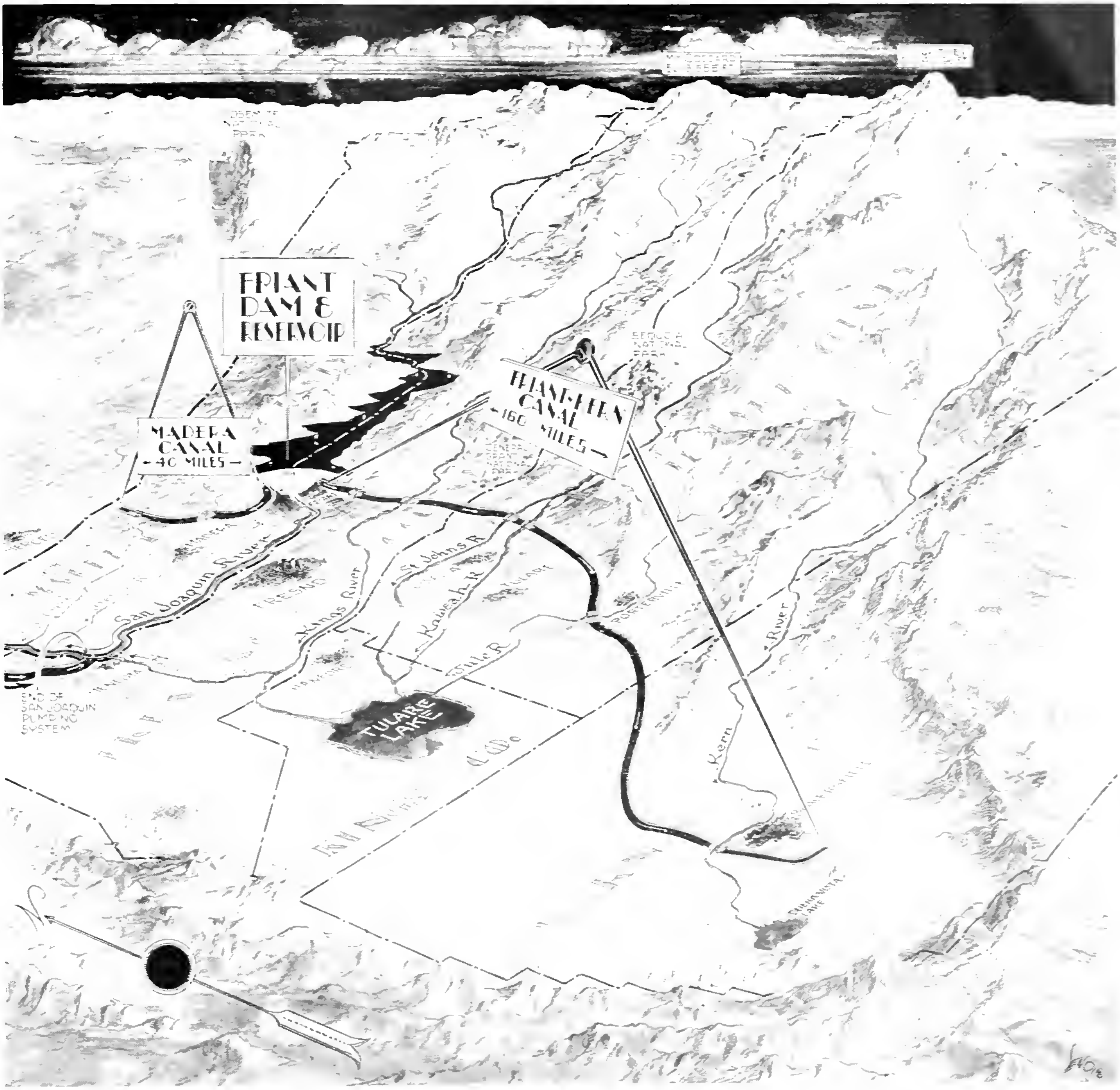
Central Valley Project Will Serve

CONSTRUCTION work on the first 8-mile section of the Madera Canal is reaching an advanced stage. This shows one of three large siphons being built. The siphon will be 600 feet long and will have a barrel about 12 feet in diameter. The Madera Canal will extend from Friant Dam on the San Joaquin River 40 miles north to the Chowchilla River and bring a new water supply to lands in Madera County.

Vast San Joaquin Valley Acreage

FRIANT DAM, now more than half completed, will impound the San Joaquin River to furnish a supplemental water supply for 1,250,000 acres of land in Madera, Fresno, Tulare, Kings and Kern Counties. This artist's perspective drawing shows the 200-mile long canal system which will carry irrigation water from Friant Reservoir as far south as Bakersfield and north almost to the Merced County line.



Future Roads

HIGHWAYS OF TOMORROW TAX INGENUITY OF BUILDERS

By CONDE B. McCULLOUGH, Assistant Oregon State Highway Engineer

Conde B. McCullough, Assistant State Highway Engineer of the State of Oregon, in an address before the highway section of the Institute of Government recently held in Sacramento, discussed "highways of tomorrow," in which he reduced certain fundamentals of economic highway planning to mathematical formulas. Excerpts from his paper are presented in the following article. Mr. McCullough bears the titles of Professor of Engineering, Doctor of Laws and Honorary Doctor of Engineering.

THE formulation of highway improvement programs has always been somewhat of an administrative "headache" but the development of the future highway plan is quite likely to aggravate this condition into a malady of major dimensions. It is true, of course, that throughout the States the nucleal systems have already been selected but transport necessities are developing at such a rate as to produce demands for betterments and extensions hitherto unpredictable—for a transportation plant designed for heavier loads, higher speeds, and unprecedented traffic densities.

How is this new plant to take shape? Out of the myriad needs how are the priorities to be established? All too frequently, in the past, improvement programs have been dictated by pressure rather than reason, by expediency rather than logic, resulting in a badly balanced growth.

THREE ESSENTIAL FACTORS

These early errors have already occasioned large economic waste, have necessitated extensive reconstruction costs. If this condition is not to be repeated it is essential that the highway transport plant of tomorrow be planned along sound lines and that there be developed a suitable criterion or "yard stick" for the measurement of economic priorities.

Basically, the problem is simple enough. It comprehends but three essential ingredients: (1) costs, (2) revenues, and (3) benefits, and the ratio in which they are interrelated. Revenues must be sufficient to balance costs, otherwise eventual bankruptcy is inevitable. Revenues must also be backed up by corresponding benefits, else the setup will collapse for lack of economic support.

These, the above, are the cardinal principles of all construction economies; and, like all good engineers who have gone before us, let us see if we can't "say it in the form of an algebraic expression."

If we let

C_t represent the total annual cost of any proposed project inclusive of every item of expense involved in its financing, maintenance and operation;

I_t represent its probable net annual revenue expectancy; and

B_t represent the annual benefits to be derived from its utilization,

we may develop two criteria in the form of quotient or ratio values, as follows:

A so-called *solvency quotient* "Q_s" measuring the financial soundness of the project, and a *benefit quotient* "Q_b" measuring its economic justification.

We may then write:

$$Q_s = I / C_t, \text{ and } Q_b = B / C_t$$

Here, then, are our "yard sticks" in algebraic form. If Q_s is less than unity the project is not self-liquidating and can only be built by subsidy. If Q_b is less than unity the project has no justification and should not be built at all. If Q_b is especially high the project may merit consideration even though it may need subsidy (provided, of course, that surplus revenues are available).

In the field of highway economies the formulas are not quite as simple as above stated for the reason that a portion of the benefits (fuel savings) operates to deplete resulting income values so that the two quotients become interrelated. Moreover, a correction is necessary to take care of that portion of the annual income derived from traffic "drained" or diverted to the new improvement from other portions of the system. Methods for applying these corrections were developed by the Oregon Highway Department and published in 1938 as Technical Bulletin No. 7.*

WHAT FORMULAS ACCOMPLISH

Let us get back to our formulas. It is true that they are somewhat crude and inexact. It is also true that the problem postulated (the development along sound economic lines of a highway plant to meet future needs) is not one which is susceptible of exact mathematical analysis since in the end the selection of both design standards and priority schedules must be tempered by human judgment and an understanding of individual conditions and needs. What good, then, are the formulas? What do they accomplish? What have we done so far?

So far we have accomplished this—we have taken our problem apart and put it together again in logical form. We have determined what we need to know. We now have a reference frame into which we may fit our experimental data. Some of our ingredient factors (costs, revenues and benefits) involve complexities which render them hopelessly difficult of exact evaluation but at least we are on the right track. We know the direction that our future research must take.

* The Economics of Highway Planning.

Let us, then, proceed to consider in turn each of the economic factors involved (C_a, I_a, and B_a). Let us see what we now know about them and what we have yet to learn.

THE COST FACTOR

This factor may be written:

$$C_a = C_{ac} + C_{am} + C_{ao}$$

where C_{ac} represents the annual cost of capital, C_{am} the annual cost for maintenance, and C_{ao} the annual cost for operation.

The first item (C_{ac}) comprehends all expense which accrues by virtue of the use or provision of funds for the project considered, and may be broken down into two components: (1) an annual charge in the nature of a fixed rental (interest) for the use of the funds involved; and (2) an annual provision for amortizing the first cost of the project during its service-life expectancy. The sum of these two may be represented by the formula

$$C_{ac} = C \cdot \left(r + \frac{r}{(1+r)^n - 1} \right) \quad \text{--- } 1$$

where "C_{ac}" represents the annual capital cost; "C" the total first cost; "r" the interest rate; and "n" the service life in years.

The second item (C_{am}) involves the maintenance expense and may be broken down into: (1) maintenance of pavement and roadway surfaces; (b) maintenance of roadbed, shoulders, and right of way; (c) maintenance of structures; (d) miscellaneous general maintenance; and (f) maintenance administration expense.

OPERATION COSTS DEFINED

The third item "operation costs" includes the expense of all of those functions and necessities which are incident to furnishing highway transportation to the public and which can not be classified either as maintenance or as capital expense. Among the various activities embraced under this designation are (a) the operation of travel and information bureaus, (b) traffic control, and such policing of highways as is required to be performed from highway funds, (c) the operation of lighting systems for roadways, bridges, tunnels, etc., (d) the development and operation of parks and recreational facilities, and (e) any other activity concerned with transportation and required to be done by the highway organization, which is not properly chargeable to either construction or maintenance.

In general the cost factor C_{ac} is susceptible of evaluation with fair accuracy once the first cost is determined, although we need to know a great deal more about service-life expectancies for the various construction components in order correctly to evaluate the term "n." The first cost element "C" (in Formula 1) will depend upon the design types necessitated by the future and here we must launch out into uncharted seas. The road of today must be designed for tomorrow, for every tomorrow during its service-life expectancy. During this period what top speeds will it be necessary and possible to provide for? What traffic densities, maximum loads, lane widths? What pavement thicknesses shall we employ? How should bridge standards be modified? To what degree will channelization, signalization, and grade separations be warranted?

In every case the answer is indicated, though highly involved. Design standards can be raised if and only if the tax structure base is or can be adjusted to meet the costs incurred. In other words, if and only if it is possible to maintain an average value of the solvency quotient "Q_s" at or above unity; and this tax structure base, in turn, can be maintained only if the benefits are sufficient to warrant.

And so our problem shifts to the other factor groups.

HIGHWAY REVENUES

The second ingredient factor, I_a, is obviously compounded from the annual traffic (in gross ton miles) and the unit net income, segregated by vehicular types. Table I hereinbelow indicates the segregation adopted by the Oregon Department, and Table II the unit net income values developed by the Oregon Highway Planning Survey.

Table II is for the highest type of roadway surface. For lower surface type standards the unit net income values will be slightly higher because of the greater fuel consumption.

The table data are of course applicable only to Oregon highways and to the Oregon Highway Tax Structure, but the various highway planning

TABLE I

ANNUAL ROAD EARNINGS

Type of Traffic	Gross Tons Per Annum	Gross Ton Miles Per Annum	Unit Net Income Per Ton Mile	Total Annual Revenue
Passenger Cars (Oregon)			$	$
Passenger Cars (Foreign)				
Trucks (Light)				
Trucks (Medium)				
Trucks (Heavy)				
Trucks with Semi-Trailer				
Trucks with Trailer				
Busses (School)				
Busses (Other)				
Other Traffic				
Total annual net income				$

TABLE II

GROUP 1—HIGHWAYS (Highest Type)

Type of Vehicle	Net Revenues Per Gross Ton Mile From			Total Net Revenues
	Registration License Fees	Motor Transportation Fees	Fuel Taxes	
Passenger cars (Oregon)	$0.000422	--------	$0.001645	$0.002067
Passenger cars (foreign)	--------	--------	0.001797	0.001797
Trucks—light	0.000563	$0.000127	0.001097	0.001787
Trucks—medium	0.000394	0.000517	0.000833	0.001744
Trucks—heavy	0.000286	0.000517	0.000558	0.001461
Trucks with semi-trailer	0.000332	0.000517	0.000559	0.001408
Trucks with full trailer	0.000426	0.000517	0.000426	0.001369
Busses (school)	--------	--------	--------	--------
Busses (other)	0.000125	0.000517	0.000723	0.001365

surveys have rendered it possible to assemble similar data for practically every State in the Union.

The annual income factor, I_a, employed in the economic equations must obviously be the average annual income during the service life of the improvement projected, so that it becomes necessary not only to determine present traffic income values but also to forecast future expectancies.

Our future highway plan is vitally dependent, therefore, upon the most careful study of traffic developments and traffic trends. Too much emphasis can not be placed upon this necessity. If our designing is to be adequate, if our systems are to remain solvent, if our growth is to be directed along sound economic lines, we must devote great thought to this phase of highway research.

HIGHWAY BENEFITS

The third ingredient, "B," is the most difficult of evaluation. Our economic equations concern themselves particularly with motorized transport benefits, although general community benefits and special land service benefits must be considered in any study of highway tax structures. Motorized transport benefits are generally broken down into (1) the "mileage element" group and (2) the "time element" group.

The mileage-element group includes, in general, those benefits which are functions of the cost of fuel, lubricants, tires, and tubes, vehicular maintenance and a pro rata of general vehicular depreciation. In general these benefits are calculated by means of a comparison of the estimated mileage-element operating cost over the improved facilities, with similar data for the facilities existing between the same termini prior to the improvement. In general, mileage-element benefits are derived from (a) a reduction in distance between termini, (b) an improvement in roadway surface, (c) a reduction in rise and fall, (d) an improvement in gradients, (e) an improved alignment, (f) the elimination of traffic stops and congestion.

(Note: Dr. McCullough [illegible] quoted extensively from Bulletin No. 10 of the Oregon Highway Department entitled "An Analysis of the Highway Tax Structure in Oregon," describing the methods for the evaluation of each of the above benefit items and the method employed in calculating time element benefits.)

The basic economic equa[illegible] applicable to the planning of long [illegible] programs may also be employed for the more detailed problems of type selection for bridges, pavements, and similar property units. This method of economic analysis applied to short-span suspension bridges is discussed in Oregon Highway Department Technical Bulletin No. 11.* Space, however, will not permit of further discussion of this point.

The above is but a most sketchy outline of the economic problems involved in the development of the future highway plan. Its purpose, as previously stated, is merely to postulate the problem, to list the data needed to fill out the frame, to point the need for further work.

MUCH DATA NEEDED

The work remaining to be done is formidable indeed. The problems are many. Among the data needed may be mentioned:

(a) Further and more accurate knowledge of service life expectancies for bridges and surface types.

(b) Additional cost data for highway maintenance and operation.

(c) A Nation-wide study of transport economics, looking toward the standardization of weight, length, and speed restrictions so that design types may be standardized without fear of untimely obsolescense. These restrictions can not be arbitrarily imposed. They must find economic justification and this again means a balancing of resultant costs, revenues, and benefits.

(d) Further data to aid in forecasting traffic trends, including a study of the various factors of influence, to the end that income expectancies may be more accurately predicted.

(e) Further data looking toward a more accurate evaluation of distance savings, reductions in gradients, and reductions in rise and fall.

(f) A more accurate determination of the value of time savings to operators, passengers, and recipients of motor transport.

(g) The effect on vehicular operating costs of surface types, lane widths, and alignment.

(h) Highway capacity studies, including the effect of channelization, signalization, and speed zoning, to the end that the economic benefits thereof may be evaluated and segregated.

(i) Accident prevention, including an economic evaluation of the various safety measures, such as grade separations, signalizations, etc.

(j) A study of future design requirements for highways, with special regard to maximum vehicular speeds, weights, and dimensions, and the extent to which additional first-cost expenditure finds economic justification.

* The Economic Analysis of Short Span Suspension Bridges.

June Traffic on State Toll Bridges Shows Heavy Increase

THE records for June indicate a continuation of the large volume of traffic which has for some time been characteristic of the three State-owned toll bridges. For the San Francisco-Oakland Bay Bridge the daily average during the month was 52,573 representing an increase of 16 per cent over June, 1940.

On the Carquinez Bridge the traffic was 88 per cent above that of the same month of 1940. This large increase appears to have been caused principally by the reduction in bridge tolls and the continued intense activity at Vallejo and Mare Island Navy Yard.

The traffic using the Antioch Bridge was much less than on the other two bridges, but showed, nevertheless, a substantial gain over the previous year.

June vehicular traffic on the San Francisco-Oakland Bay Bridge and the Carquinez and Antioch bridges is shown in the following tabulation:

	San Francisco-Oakland Bay Bridge	Carquinez Bridge	Antioch Bridge
Passenger autos and auto trailers	1,431,226	370,802	21,510
Motorcycles and tricars	4,193	1,145	56
Buses	30,235	5,241	181
Trucks and truck trailers	80,485	27,354	3,318
Others	31,039	238	115
Total vehicles	1,577,178	404,780	25,180

Gas Tax AS APPORTIONED TO CALIFORNIA COUNTIES DURING THE 91st AND 92d FISCAL YEARS

GASOLINE tax apportionments to the counties of California for the fiscal year July 1, 1940, to June 30, 1941, will make the counties' share of gas tax funds for the present biennium total $33,962,279.75.

During the Ninety-first Fiscal Year which ended June 30, 1940, the counties received $16,652,561.22. During the Ninety-second Fiscal Year ending June 30, 1941, they will receive $17,309,718.53, an increase of $657,157.31.

In apportioning gas tax moneys to the counties, each such political subdivision first receives a minimum of $7,500. The remainder is allocated in the proportion that the registration of motor vehicles in each of such counties bears to the total number of vehicles registered in the State.

California's motor vehicle registration as of April, 1941, on which was based the apportionment to counties for the present fiscal year was 2,775,635.

Apportionments were as follows:

County	Ninety-first Fiscal Year July 1, 1939, June 30, 1940	Ninety-second Fiscal Year July 1, 1940, June 30, 1941	Totals Ninety-first and Ninety-second Fiscal Years
Alameda	$1,058,666.98	$1,100,600.39	$2,159,267.37
Alpine	30,814.58	30,806.13	61,620.71
Amador	49,814.59	50,176.98	99,991.57
Butte	138,919.29	140,079.11	278,998.40
Calaveras	50,680.97	51,118.25	101,799.22
Colusa	58,542.26	57,513.18	116,055.44
Contra Costa	241,188.16	258,374.25	499,562.41
Del Norte	41,111.35	41,114.99	82,226.34
El Dorado	58,902.06	59,789.08	118,691.14
Fresno	453,583.68	469,658.15	923,241.83
Glenn	63,717.23	63,770.32	127,487.55
Humboldt	130,903.21	132,474.06	263,377.27
Imperial	170,281.23	170,514.05	340,795.28
Inyo	49,118.93	49,940.26	99,059.19
Kern	350,714.36	366,364.88	717,079.24
Kings	114,451.07	119,975.05	234,426.12
Lake	52,741.44	52,819.42	105,560.86
Lassen	60,249.66	63,212.41	123,462.07
Los Angeles	6,114,103.59	6,429,486.64	12,543,590.23
Madera	84,939.39	87,777.03	172,716.42
Marin	123,804.94	128,498.32	252,303.26
Mariposa	43,488.95	43,227.02	86,715.97
Mendocino	84,738.93	85,711.70	170,450.63
Merced	137,038.83	142,668.37	279,707.20
Modoc	49,320.92	50,540.24	99,861.16
Mono	34,899.51	34,946.11	69,845.62
Monterey	195,742.42	209,832.81	405,575.23
Napa	91,108.01	94,882.06	185,990.07
Nevada	70,732.14	71,635.16	142,367.30
Orange	362,055.99	365,050.19	727,106.18
Placer	97,297.99	98,155.88	195,453.87
Plumas	52,022.44	54,161.03	106,183.47
Riverside	267,877.80	272,426.74	540,304.54
Sacramento	415,162.90	432,415.32	847,578.22
San Benito	60,006.36	60,011.43	120,017.79
San Bernardino	382,138.77	394,146.98	776,285.75
San Diego	622,967.53	673,477.92	1,296,445.45
San Francisco	1,045,712.07	1,073,522.29	2,119,234.36
San Joaquin	325,746.72	332,681.27	658,427.99
San Luis Obispo	114,092.70	119,096.49	233,189.19
San Mateo	257,616.44	275,570.83	533,187.27
Santa Barbara	204,802.28	206,377.63	411,179.91
Santa Clara	448,354.81	457,896.99	906,251.80
Santa Cruz	143,051.92	143,272.77	286,324.69
Shasta	96,367.51	104,632.73	201,000.24
Sierra	36,579.55	36,221.34	72,800.89
Siskiyou	91,875.30	94,579.60	186,454.90
Solano	132,779.32	142,924.73	275,704.05
Sonoma	207,359.61	209,830.07	417,189.68
Stanislaus	219,380.00	222,759.55	442,139.55
Sutter	75,744.64	77,002.49	152,747.13
Tehama	67,319.44	66,874.92	134,194.36
Trinity	38,367.39	38,655.82	77,023.21
Tulare	272,713.40	281,825.80	554,539.20
Tuolumne	55,710.70	56,317.77	112,028.47
Ventura	183,021.04	186,753.62	369,774.66
Yolo	99,189.27	100,016.10	199,205.37
Yuba	72,928.65	75,553.81	148,482.46
Total	$16,652,561.22	$17,309,718.53	$33,962,279.75

Pan-American Highway Will Be Discussed in Mexico City

The fourth Pan-American Highway Congress, meeting in Mexico City September 15th to 24th, will have as one of its important topics for discussion the subject of the development of the Inter-American Highway System. Delegations from each country represented will report on the status of construction and the program for future activities.

A permanent organization of Pan-American Road Congresses will be effected. The delegates will discuss connecting points of the Pan-American Highway at international borders, the financing of the highway and the extension of the system for insular republics.

The Inter-American Federation of Automobile Clubs will discuss cooperation in the development of international traffic and special signs and markers.

Construction Progress on U.S. 40

(Continued from page 8)

future swelling, with the accompanying distortion of the pavement, a clause is included in the new contract requirements providing for the wetting of the lower quality material underlying the gravel sub-base until the upper two-foot portion has a moisture content between 17 per cent and 25 per cent.

The completion of the work now under contract will provide a divided four-lane highway from the South Fork of Putah Creek to the Yolo Causeway. Plans are now being made to develop other sections of this road between Dixon and Sacramento to the same standards as rapidly as funds become available.

Fredericksen and Westbrook are the contractors on the work and J. W. Corvin is the resident engineer.

Coast Road

GRADING PROJECT, WATSONVILLE TO ROB ROY, IS NEAR COMPLETION

By A. WALSH, Resident Engineer

THE LEGISLATIVE act of 1933, added to the State Highway System that portion of the Coast Road between Santa Cruz and Watsonville in Santa Cruz County.

This section of two-lane concrete pavement has developed a heavy traffic flow in excess of the safe capacity of the road.

To relieve this traffic burden a major construction project has been under study for several years.

The State Highway Budget for the Ninety-first - Ninety-second Fiscal Years provided funds for stage construction of a portion of this road which is now under contract.

This contract, 6.2 miles in length, connecting with the City of Watsonville on the east, consists, in general, of constructing a 47-foot graded roadbed sufficient for a three-lane pavement and seven-foot shoulders, widened to a 64-foot roadbed over summits where sight distance is limited.

The work was let to contractors N. M. Ball Sons, of Berkeley, in December, 1940.

The new location lies between the present road and the coast line and crosses several old tidal channels which have filled up with alluvial waste and vegetable matter in the form of peat land. The peat formation in these areas vary in depth of from 10 to 43 feet.

These areas required special foundation treatment to support the superimposed loads placed thereon by the highway fills. Test borings were made to determine the character and depth of the peat formation and it was decided to stabilize the foundations at Harkins and Watsonville Sloughs by constructing vertical sand drains to permit the escape of ground water as pressure was applied to the surface by placing the fill. These drains were constructed by drilling wells 20 inches in diameter through the peat formation, varying in depth from 10 to 43 feet, spaced on 13 foot centers parallel to center line and on 11-foot centers at right angle to center line.

To insure the wells being free of sediment before backfilling, clear water was injected into the well and removed by a suction pump which carried away the silt and sediment. This process was continued until the water ran clear, after which the wells were backfilled with a clear graded sand.

A three-foot sand blanket is being placed over the entire area to provide a drainage outlet from the sand drains.

To determine the rate of settlement and side pressures being developed by placing the fill and the safe rate at which the load can be placed, pressure gauges connected with well points placed at the bottom of the peat formation are located at the sides of the fill and settlement platforms are installed at intervals beneath the fills.

From these platforms one-inch pipe is extended vertically as the fills are constructed, and level readings taken thereon to determine the amount and rate of settlement.

From this data the rate at which the fills may be constructed without causing undesirable displacement of the foundation material is determined.

Some 70,000 cubic yards of material will be required for the 35-foot fill at Harkins Slough and is the larger of the two being treated with vertical sand drains.

At several other crossings of peat land formation overloading of the foundation by increasing the height of the fill is being done. The largest of these is at Struve Slough where 81,000 cubic yards of fill material will be placed, 35,000 cubic yards of which is provided for subsidence and displacement of the peat land foundation.

The peat at this location has a maximum depth of 35 feet. The height of the grade line above the natural ground is 35 feet.

Results secured from these alternate methods of hastening settlement and ultimate stabilization of the roadway will be interesting and valuable.

The northwesterly section of the new location is through rolling hills with vistas of the coast line and Monterey Bay in the distance and will unquestionably develop as potential home sites.

Throughout the project cut slopes have been flattened to 1½ to 1 and will be covered with six inches of top soil sown with grass seed to retard erosion.

Some of the major contract items on this job are:

1,225,000	cubic yards roadway excavation.
16,190	lin. ft. of 20″ diameter drilled wells for fill stabilization at slough crossings.
9,000	lin. ft. of corrugated metal pipe of various diameters.
490	cubic yards concrete.
60,000	lbs. reinforcing steel.
10,000,000	sta. yds. overhaul.

Contract cost $285,481.00.

The project is being financed from both State and Federal aid funds.

Approach roads on the project are held to a minimum and are restricted to locations consistent with safety.

The grading is being done by means of seven 18 cubic yard carryalls powered with RD8 tractors; three 12 cubic yard Turnapulls; and one 14 cubic yard Euclid. The Turnapulls and Euclid units are relatively new on highway construction. They are self-powered, have a short turning radius, and have a speed of approximately 20 miles per hour.

The terrain which the road traverses contains many springs and ground water which are being treated by constructing trenches through the water bearing strata and backfilling same with drain rock.

(Continued on page 24)

Construction on new Rob Roy-Watsonville Highway is proceeding rapidly. Upper—Truck loading with tractor pushing. In right foreground, Bulldozer in operation and in background, two Turnapulls hauling to fill. Lower—Huge fill being made.

San Rafael VIADUCT WILL DO MUCH TO RELIEVE MARIN COUNTY TRAFFIC CONGESTION

By T. E. FERNEAU, Resident Engineer

CONSTANT turmoil has been the record of highway transportation through Marin County. Elimination of one point of congestion has only accentuated a bottleneck at some other location, with highway improvements lagging far behind the ever increasing traffic volume.

Replacement of the shuttling ferry system to San Francisco by the six-lane Golden Gate Bridge and the Waldo Approach eliminated the ferry bottleneck which in the past caused traffic to back up for miles with a delay period running into hours. But the elimination of this traffic block caused immediate and serious congestion in the City of San Rafael, where the Redwood Highway passes over already crowded city streets.

The Redwood Highway serves as an important link in the social and economic life of the vast Northern California coastal counties. Stretching through the whole of this area, which abounds in vacation and recreational opportunities, the highway carries its heaviest pleasure car volume during the summer vacation months. Because of limited rail facilities, truck traffic is not only extremely heavy, but is of vital necessity to the entire region. These freight vehicles are at times as high as 12 per cent of the total traffic, or an average of one truck in every eight vehicles.

This important arterial is fed by laterals reaching out in all directions into the great agricultural, recreational and residential areas. Throughout its length, traffic reaches the main highway via these feeders and accumulates to a peak volume at San Rafael.

With normal counts running as high as 1,350 vehicles per hour over a 16-hour period, and with trucking contributing a relatively large percentage of the total, some idea may be gained of the problem facing the highway planner who is always plagued by the sure knowledge that the funds available will be very limited.

The type of mixed vehicular traffic found on the Redwood Highway is particularly difficult to handle when forced to use the streets of a thriving busy city like San Rafael.

Since the highway traffic passes

View of highway viaduct through San Rafael, which is nearing completion

Section of new divided highway north of San Rafael, which will relieve congestion in that city

over city streets, with all crossings at grade, serious congestion has been impossible to avoid and city traffic is often forced to a standstill during long periods when through traffic is at a peak.

EARLY STUDIES

The Division of Highways has been acutely aware of this situation for many years and studies were begun in 1932 to determine the best means of breaking the San Rafael bottleneck. Many routes were surveyed, studied and subjected to exhaustive analysis to determine their adequacy for the traffic of tomorrow and to compare them on a basis of original price and yearly maintenance costs.

In keeping with the modern trend toward moving highways away from cities to permit smooth frictionless flow of through traffic and yet serve the needs of the local communities, it was planned to remove the highway from the San Rafael city streets in the only manner that seemed feasible for both present and future needs—that is, by an elevated structure that would separate the grades and thus provide the best facilities for separating the through and local traffic.

Construction of the viaduct was started in July, 1940.

COMPLETED NEXT FALL

The sections of viaduct remaining to be constructed include the longer spans using the heavier types of reinforcement, and nearly 35 per cent of the total amount of steel is yet to be placed. It is anticipated that the project will be completed by September 1, 1941.

The viaduct is 2207 feet 6 inches in length. It has a center dividing strip to separate traffic flowing in opposing directions, with two traffic lanes on each side between the parting strip and the curb. A separation of grades between all major city streets is effected.

In general design, it is composed of two types of construction. A section at either end is of slab construction with spans varying from 23 to 30 feet in length and with parabolic slab bottoms. These end sections are connected by beam and girder construction, with spans varying from 36 feet 11 inches to 57 feet 6 inches. The columns supporting the slab sections are rectangular but those supporting the girders are tapered from the top towards the footing. Since the bottom of the girders as well as the bottom of the slabs are parabolic, they combine with the tapered columns to give the entire structure a very pleasing effect from an architectural viewpoint. All foundations for the structure are concrete footing blocks supported by driven fir piling. The piling used, if placed end to end, would have a length of nearly 15 miles.

UNIQUE FEATURE

One of the unique features of the work was the clever adaptation of the pile driving rig to drive a large number of inclined piles in the various foundations. The plans call for piles to be battered in two directions, sideways from centerline and either ahead or back on line, with the batter as great as one in four. For setting and driving these piles, double moonbeams—two pairs at right angles to each other—were cut from large timbers and mounted on the pile driver frame. With extra bracing and some minor rebuilding the pile driving contractor converted the 60-foot skid rig to satisfactorily handle piles inclined on any batter up to the one on four maximum and in both of the required directions.

Despite the low cost per square foot of deck area, this structure designed to care for modern transportation demands, is less than one-half mile long and contains sufficient concrete to build over 11 miles of the type and width of concrete road that adequately served the needs of this region some 20 years ago.

The creek draining a large area of the city runs directly under and follows the line of the viaduct for a distance of about 1,200 feet. To properly control the flow through this channel it will be rebuilt directly down the centerline of the structure where storm waters can flow between the columns without danger to the viaduct substructure. New concrete culverts are required under each of four major city streets.

CONSTRUCTION PROBLEMS

It is customary to think of a bridge as something to span across a creek but certainly somewhat unusual for a structure to be located directly over a creek for a distance of 1,200 feet. This feature caused many construction problems during the rainy season due to flood waters flowing through the foundation excavations. After each heavy rain, the footing excavations would be refilled with mud and debris for a depth of six to eight feet and it was necessary to again excavate them. Some of the excavations were cleaned out as many as ten times in an effort to keep the job progress from falling too far behind schedule.

The relatively short periods of fair weather occurring during the rainy season would not permit the placing of large sections of formwork where concrete could be poured before excessive weathering ruined the forms and it was decided to pour the supporting columns up to ground line only and return after the seasonal torrents to complete the work. This proved to be a fortunate change as it permitted at least some of the work to be carried on at times when the entire project would have been completely stopped under any other plan.

The plans for highway reconstruction near the south end of the viaduct called for traffic from the south destined for San Rafael to be routed over the old Irwin Street entrance to the city. In order to complete these plans, it was part of the work embraced by the viaduct contract to construct a triangular shaped bridge at the San Rafael Harbor crossing. While working on this structure it was noted that the adjacent Irwin Street bridge was in very poor condition and that heavy loads being hauled over it made immediate replacement desirable. Discussions were started with city officials relative to replacing the existing bridge. The city welcomed such an improvement and with its participation a new two-span concrete bridge supported on concrete piling was built and the old unsafe wooden bridge removed.

TIME SAVED

The San Rafael viaduct will allow the Redwood Highway to assume an even more important role in the economic and social welfare of the northern coastal area than it has in the past, as it is essentially a time saver.

Time saved is an important and definite economic factor where there is heavy commercial traffic such as there is on this arterial, and it has a definite monetary value to both the industry whose time is directly saved and to society at large.

Less tangible perhaps but equally important in the long range view, is the time saved by countless pleasure cars and the lessened wear and tear on the human system when driving over a modern highway as compared with the older roads with their lower standards of curvature, grades and widths; and the never ending succession of restricted speed zones and other obstacles to free traffic flow.

With the Nation's major efforts now concentrated upon problems of National defense and with present day military units almost completely mechanized, rapid transportation facilities between strategic points becomes a matter of primary importance in case of war.

During recently observed practice maneuvers, troop movements were considerably hampered by using the present route through San Rafael and local traffic was completely disrupted.

Completion of the new skyway will eliminate San Rafael as an obstacle to rapid military transportation through this region.

Pit River Bridge Agreement With U. S. Is Signed

On behalf of the State of California, Director of Public Works, Frank W. Clark, has signed an agreement with the United States under which the Division of Highways and the Southern Pacific Railroad Company jointly will maintain and operate the five million dollar Pit River Bridge the world's highest double-deck span which is being constructed by the United States Bureau of Reclamation to reroute the Pacific Highway and the railroad around the Shasta reservoir.

The contract signed by Clark has been under negotiation between the Federal and State Governments and the railroad company for approximately two years. Title to the bridge is to remain permanently in the United States. It will be maintained by the State and railroad company at their expense, the State receiving from the Federal Government a perpetual easement for the exclusive highway facilities.

The agreement provides in detail for the method of determining the cost of maintenance and the items which shall be included in computing the same, as well as liability and indemnification of the respective parties in connection with the maintenance. The agreement also provides for the accommodation on the bridge of certain distribution and communication lines of Pacific Telephone and Telegraph Company, Western Union Telegraph Company, Postal Telegraph-Cable Company and Pacific Gas and Electric Company.

Edith: "Dick, dear, your office is in State Street, isn't it?"

Dick: "Yes; why?"

Edith: "That's what I told Dad. He made such a funny mistake about you yesterday. He said he'd been looking you up in Bradstreet."

A girl was discovered crying bitterly the other day. Her mother asked her what was the matter.

Little Girl (wailing)—Boo hoo! My new shoes hurt me!

Mother—Well, no wonder. You have them on the wrong feet.

Little Girl (protesting)—I haven't any other feet.

Yearly Storms Do Costly Damage to the State Highways System

(Continued from page 10)

feet before corrective measures could be started.

HUGE EARTH MOVEMENT

It is estimated that approximately one-quarter million cubic yards of earth are in motion, and it is hoped that the removal of between 50,000 and 80,000 cubic yards, in the form of benches as illustrated in the diagram, will be sufficient to stop the movement. This is not certain, however, and it may be necessary to remove more material from the upper bench in order to bring the slide completely under control.

The removal of the lower bench, marked (3) on the diagram, is for the purpose of stabilizing the lower or secondary slide. Since it was necessary, in any case, to move some of the material twice, it was decided to place this material in a form of a temporary counterweight (2) in order to slow up the movement pending the completion of the bench excavation. The removal of this temporary counterweight will be the last operation to be performed.

It is believed that the moisture which caused this slide resulted from percolation of surface waters, since no evidence of underground sources of water was apparent. This cut had never caused trouble previously and would probably have remained stable indefinitely under normal conditions of rainfall.

RAINY SEASON BAD

In an 18-mile section between Castaic and Alamos Creek, which was completed in 1933, 15 slides and slipouts have developed during the past rainy season. Several of these are shown in the accompanying photos, and diagrams of typical cases show the proposed method of correction.

The immediate cause of these failures was the excessively heavy rainfall during the past winter. Unfavorable geological conditions in this area were a contributing cause, since the formations encountered consist largely of soft clay shales which weather to considerable depths and become soft and plastic when saturated. These materials also are difficult to compact in embankments. In some portions of this area comparatively hard sandstones occur, but these are invariably interbedded with thin shale strata which become plastic and slippery when wet and thus induce slides along the bedding planes where the strata dip toward the roadway.

This was one of the first projects to be constructed on a high standard of grade and alignment through rugged mountainous country. It was built during a cycle of dry years when adverse subsurface moisture conditions were not apparent, and at a time when little was known about modern soil mechanics and its application to foundation and stability studies in connection with highway construction. Much has since been learned about the stability of cuts and fills, and about methods of anticipating and preventing them.

CORRECTION MEASURES

The general methods of correcting the more serious slipouts are shown in the accompanying diagrams.

For some of the smaller slipouts and some of the fills which are showing the first signs of instability, the corrective measures proposed will consist of drainage by means of perforated pipes installed in borings which are made by means of a horizontal power auger. These borings can be made at comparatively low cost, and it is believed that such drainage measures will reduce the moisture content and lower the ground water sufficiently to stabilize these fills which are showing the first signs of failure.

There is considerable evidence that much of the water which is saturating the fills is coming from seepage in cut sections which drains downgrade into the adjoining fills. In some cases a considerable flow of water has been found traveling under the concrete pavement. An extensive program is contemplated to eliminate this source of water by constructing longitudinal subdrains along the gutter line in cut sections with transverse drains across the highway at the ends of the cuts.

The three major slides on the Ridge Route which are shown in the photographs involve an estimated total of approximately 200,000 cubic yards. In addition to this amount, it is estimated that minor slides on this route will total 67,000 cubic yards.

The following is a rough estimate of the total quantities involved in the correction of the slides and slipouts described for the two locations.

The cost of this work will be approximately $330,000.

	Ridge Route	Kellogg Slide	Total
Excavation (cu. yds.) ______	490,000	80,000	570,000
Horizontal Borings (lin. ft.)	6,300		
Diversion Trenches (lin. ft.)_	38,000		
Gravel for porous drains (cu. yds.) ____________	5,000		
24-inch culvert pipe (lin. ft.)	280		
72-inch culvert pipe (lin. ft.)	200		
Bituminous Surfacing (tons)_	800	1,100	1,900

In the preliminary investigation of proposed construction projects, the soil survey and foundation investigation is becoming increasingly important. The location of the highway should be influenced to a considerable extent by conditions disclosed by geological studies and boring investigations, in order, where possible, to avoid cuts in unstable soils or in stratified rocks where the dip is unfavorable. Cut slopes should be designed sufficiently flat or should be benched to avoid major slides, and fill foundations should be adequately drained, especially where the cross-slope of the ground is appreciable. A thousand dollars spent on the preparation of a fill foundation may prevent a slipout which would cost from 10 to 30 times that amount to correct.

California Leads

With California leading all the States in the Union, the third largest annual increase in registration of motor vehicles since the depression occurred in 1940, the Public Roads Administration of the Federal Works Agency announces.

Public, private and commercial motor vehicles registered in California last year totaled 2,810,566. New York State was in second place with a registration of 2,778,312. Pennsylvania was third with 2,169,702 vehicles. Six States, Illinois, Indiana, Michigan, New Jersey, Ohio and Texas exceeded 1,000,000 registrations each.

Highway Bids and Awards for June, 1941

CALAVERAS COUNTY—Between Ames and South Fork of Mokelumne River, about 3.6 miles in length to be graded and surfaced with road-mixed surfacing on a base of imported borrow. District X, Feeder route. Claude C. Wood, Lodi, $118,038; Harms Bros., Sacramento, $123,371; Johnston Rock Co., Inc., Stockton, $125,254; A. Teichert & Son, Inc., Sacramento, $131,422. Contract awarded to Elmer J. Warner, Stockton, $117,160.

CONTRA COSTA COUNTY—A toll plaza for the Antioch Bridge at its south approach, consisting of a toll booth, reinforced concrete scale pit, scales, concrete roadway widening and appurtenances thereto. District IV, Route 11, Section A. Underground Construction Co., Oakland, $19,971; D. W. Nicholson Corp., San Leandro, $21,005; Albert H. Siemer and John Carcano, San Anselmo, $21,211. Contract awarded to M. A. Jenkins, Sacramento, $17,673.

FRESNO COUNTY—Between White Deer Road and Sequoia Forest Boundary, about 3.4 miles, bituminous surface treatment to be applied to the existing roadbed. District VI, Route 41, Section T. Geo. E. France, Visalia, $13,245. Contract awarded to Oilfields Trucking Co., Bakersfield, $12,786.

HUMBOLDT COUNTY—Across Eureka Slough at Eureka, a bridge having an overall length of 849 feet 6 inches consisting of two steel truss spans and 17 reinforced concrete girder spans to be constructed and approaches about 0.7 mile in length to be graded and surfaced with plant-mixed surfacing on a gravel base. District I, Route 1, Sections Eur &II. A. Soda & Son, Oakland, $304,678; C. W. Caletti & Co., San Rafael, $306,514. Contract awarded to Ralph A. Bell, San Marino, $289,478.

KERN COUNTY—Between Levee Canal and S. P. railroad crossing at Oildale, about 1.2 miles to be graded and surfaced with asphalt concrete. District VI, Route 142, Section A. Piazza & Huntley, San Jose, $105,325; A. Teichert & Son, Inc., Sacramento, $113,021. Contract awarded to Griffith Co., Los Angeles, $94,951.35.

LOS ANGELES COUNTY—On Bellflower Boulevard between 0.3 mile south of South Street and Artesia Avenue, about 1.3 miles, to be graded and surfaced with plant-mixed surfacing. District VII, Route 169, Sections A,LBch. Nick Perscallo, Los Angeles, $37,888; Griffith Co., Los Angeles, $38,857; Vido Kovacevich, South Gate, $39,135; Oswald Bros., Los Angeles, $42,722; Sully Miller Contracting Co., Long Beach, $44,603. Contract awarded to J. E. Haddock, Ltd., Pasadena, $35,942.

LOS ANGELES COUNTY—At Topanga Creek near Santa Monica, a reinforced concrete girder bridge to be constructed and about 0.27 mile to be graded and surfaced with plant-mixed surfacing and bituminous surface treatment applied to shoulders. District VII, Route 156, Section A. J. S. Metzger & Son, Los Angeles, $77,629; The Contracting Engineers Co., Los Angeles, $81,797. Contract awarded to J. E. Haddock, Ltd., Pasadena, $61,241.

LOS ANGELES COUNTY—Between Cypress Avenue and Big Dalton Wash, about 0.6 mile to be graded and surfaced with plant-mixed surfacing. District VII, Route 62, Section D. Wm. C. Horn Co., Pomona, $13,640. Contract awarded to J. E. Haddock, Ltd., Pasadena, $11,116.

MENDOCINO-HUMBOLDT COUNTIES—Between Ridgewood Ranch and one mile north of Dyerville, about 5.9 miles to be surfaced with imported borrow and road-mixed surfacing. District I, Route 1, Sections D,H,B,D. Contract awarded to Claude C. Wood, Lodi, $27,900.

MERCED COUNTY—At points between 12 and 18 miles east of Los Banos, 7 bridges to be widened and approaches thereto to be widened and surfaced. District X, Route 32, Section C. Earl W. Heple, San Jose, $52,927. Contract awarded to Kiss Crane Service, Berkeley, $38,174.

MODOC COUNTY—Between Likely and Cedar Pass, about 13.3 miles, construction of a graded roadbed, placing road-mixed surfacing and seal coat on imported borrow on a portion, placing plant-mixed surfacing and seal coat upon imported borrow on other portions. District II, Routes 73, 28, Sections C,D,Alt,C. Contract awarded to Harms Bros. & Powers & Patterson, Sacramento, $97,368.

PLACER COUNTY—Between Lincoln and Yuba County line, about 2.5 miles to be surfaced with plant-mixed surfacing. District III, Route 3, Section B. Contract awarded to Hemstreet and Bell, Marysville, $12,350.

PLUMAS COUNTY—Between Crescent Mills and Greenville, about 4.2 miles to be surfaced with road-mix surfacing. District II, Route 83, Section B. Poulos & McEwen, Sacramento, $22,694; Lee J. Immel, Berkeley, $25,663. Contract awarded to Oranges Bros., Stockton, $17,831.

PLUMAS COUNTY—Between Quincy and Western Pacific Subway about 6.8 miles to be graded and surfaced with gravel base and plant-mixed surfacing and reinforced concrete box culverts to be constructed. District II, Route 21, Section D. Johnston Rock Co., Inc., Stockton, $149,346; Fredrickson Bros., Emeryville, $150,750; Hemstreet & Bell, Marysville, $153,032; Parish Bros., Sacramento, $171,745; Isbell Construction Co., Reno, $183,058. Contract awarded to Harms Bros., Sacramento, $134,110.

RIVERSIDE COUNTY—Across Pinto Gulch about 26 miles east of Indio, a bridge to be constructed. District XI, Route 64, Section I. Hensler & MacDonald, Highway Highlands, $26,830; Roland T. Reynolds, Anaheim, $28,225; The Contracting Engineers Co., Los Angeles, $29,696. Contract awarded to J. S. Metzger & Son, Los Angeles, $25,623.

SACRAMENTO COUNTY—Between the American River bridge and North Sacramento, a reinforced concrete viaduct to be constructed and about 0.4 mile of roadway to be graded and paved with portland cement concrete, asphalt concrete and plant-mix surfacing. District III, Route 3, Section B, N. Sac. Heafey-Moore Co. & Fredrickson & Watson Construction Co., Oakland, $637,144; Campbell Construction Co, Sacramento, $548,843; A. Soda and Son and Parish Bros., Oakland, $641,611. Contract awarded to Earl W. Heple, San Jose, $528,136.

SACRAMENTO COUNTY—Across Cosumnes River and Overflow channels, bridges to be repaired. District III, Route 4, Section A. F. Kaus, Stockton, $15,280; Albert H. Siemer & John Carcano, San Anselmo, $22,114. Contract awarded to M. A. Jenkins, Sacramento, $14,722.

YOLO COUNTY—Across Sacramento River at Knights Landing, leaves of existing bascule bridge to be redecked. District III, Route 87, Section A. P. F. Bender, North Sacramento, $9,945; M. A. Jenkins, Sacramento, $10,781; F. Kaus, Stockton, $13,621; Lee J. Immel, Berkeley, $13,253. Contract awarded to C. C. Gildersleeve, Berkeley, $9,844.

Supreme Court Upholds Authority of Public Works

(Continued from page 11)

The decision is important because it clearly is applicable to the whole question of regulation of encroachments in State highways, including those existing pursuant to permits issued by the department. It is important, also, because:

It upholds validity of Section 680 of the Streets and Highways Code;

It validates, in effect, the procedure adopted by the department for the relocating of the water main;

It clarifies the authority of the department over holders of so-called "State franchises" to occupy highways, including rights conferred by Section 536 of the Civil Code, by the Irrigation District Acts, Public Utility District Act, Metropolitan Water District Act, by former Section 19 of Article XI of the Constitution, and other similar enactments.

The legal office wishes to express its appreciation of the cooperation received from Colonel Jno. H. Skeggs, District Engineer, District IV, and Mr. E. G. Poss and other members of the district staff, in preparation and trial of the case in the superior court.

Coast Road Grading Project Near Completion

(Continued from page 18)

The project is operating on a two-shift basis and at the present rate of progress will be completed well ahead of schedule.

The budget for the Ninety-third-Ninety-fourth Fiscal Years provides funds for completion of the grading from the end of the present project to a connection with the old road at Rob Roy and for surfacing the project from Watsonville to Rob Roy.

When this work is completed, an overtaxed traffic artery will be relieved, saving more than two miles of travel distance between Watsonville and Santa Cruz.

The military value of this improvement is significant by reason of the fact that it makes easier access to Camp McQuaide, which is located between the highway and the ocean, and also shortens travel time and relieves traffic congestion between the many military training camps in this coast area.

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Seattle Public Library,

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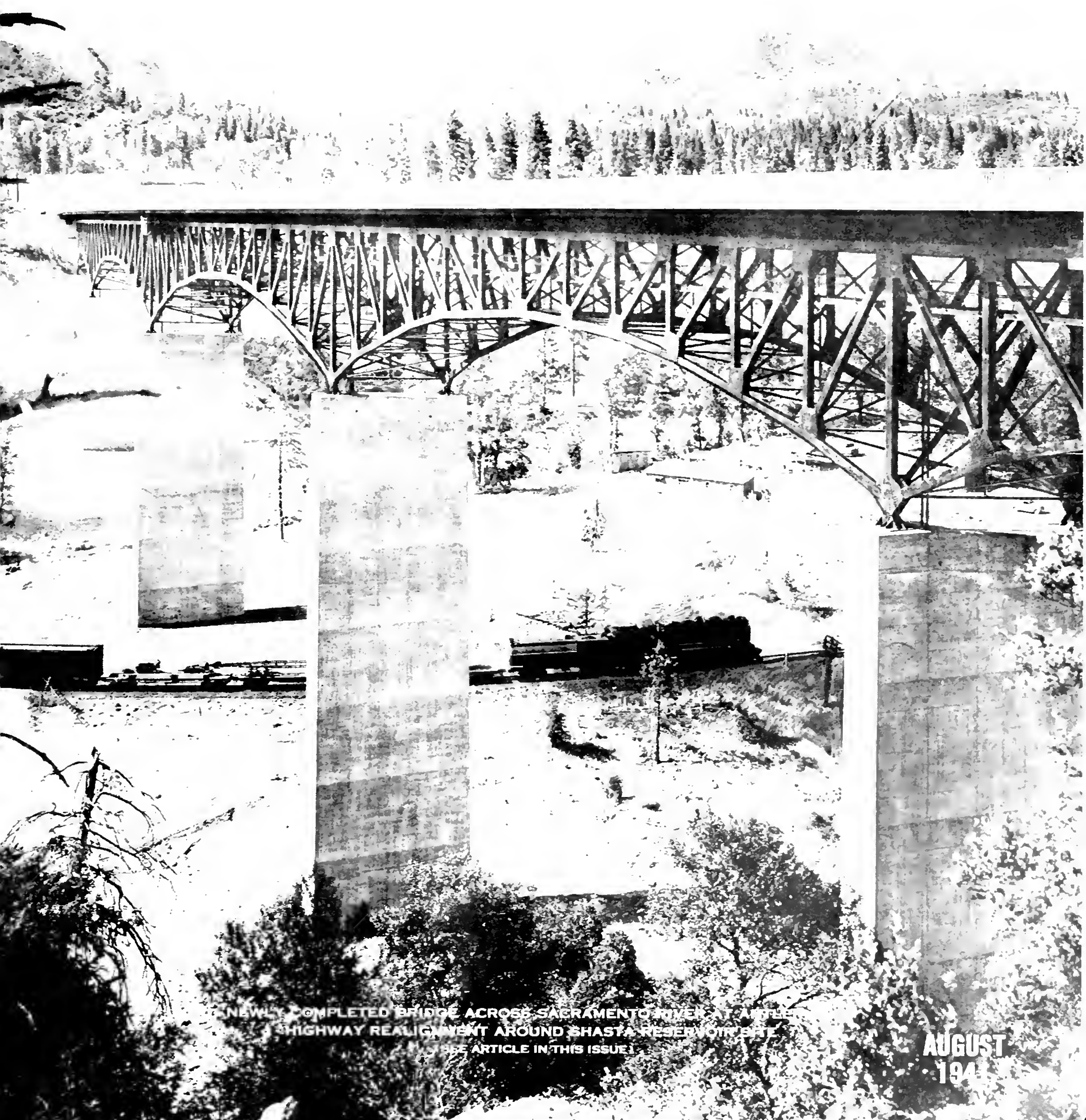
CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



NEWLY COMPLETED BRIDGE ACROSS SACRAMENTO RIVER AT ANTLER
HIGHWAY REALIGNMENT AROUND SHASTA RESERVOIR SITE
(SEE ARTICLE IN THIS ISSUE)

AUGUST
194

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California

FRANK W. CLARK, Director — C. H. PURCELL, State Highway Engineer — J. W. HOWE, Editor — K. C. ADAMS, Associate Editor

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Vol. 19 — AUGUST, 1941 — No. 8

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Antler Bridge

UNIT COMPLETED IN RELOCATION AROUND SHASTA RESERVOIR SITE

By F. W. PANHORST, Bridge Engineer

THE completion of the Sacramento River Bridge at Antler in Shasta County early this month marks an important step in the fulfillment of the task of relocating approximately 16 miles of State Highway in the Sacramento, Pit, and McCloud River canyons made necessary by the construction of the Shasta Dam near Kennett. A combination highway and railroad bridge across the Pit River is scheduled for completion next Spring.

The contract for the construction of the bridge at Antler, amounting to $680,000, was one of the major Division of Highway contracts concerned in the highway relocation work. The other contracts covered the grading and surfacing of the entire stretch of new highway. Funds for the work were supplied jointly by the United States Bureau of Reclamation and by the State of California. Approximately 75 per cent of the cost of the bridge was borne by the Bureau of Reclamation with the State supplying the balance.

BUILT ON CURVE

The bridge is a steel deck structure, 1,330 feet in length, on concrete piers and abutments. The roadway is on a 5,000-foot radius curve compounding into an 850-foot radius curve about 80 feet north of the south abutment. The entire structure is on a descending vertical curve of −2.5% grade at the south end and a −4.25% at the north end. The roadway width is 30 feet and two 2-foot 6-inch sidewalks are also provided.

There are five major spans: two of 189 feet, two of 252 feet, and the central span which is 273 feet long. The 273-foot span consists of a 147-foot truss supported by two 63-foot cantilever arms. A steel stringer approach span at each end of the structure is supported by the abutment and the 42-foot cantilever arm.

The pier heights vary considerably, the tallest being 172 feet above footing grade. The piers are 8 feet wide by 40 feet long at the top and the sides are battered ¼-inch per foot to provide a pleasing appearance.

They are of cellular construction, using 18-inch walls and interior ribs throughout. Varying amounts of reinforcing steel in these walls provide for the differences in stress at the proper points. All piers are founded on rock.

Three of the piers extend down below river level and required concrete foundations poured under water. Construction joints are provided in the pier shafts at 20-foot intervals; a horizontal distribution girder, or "floor," being located at these points. Piers are battered ½-inch to 12-inch for appearance.

As the ultimate water level in the Shasta Reservoir will practically submerge the main piers, openings are provided at various points in the pier walls and floors to permit the free passage of water. This procedure not only eliminates hydrostatic pressure on the pier walls but adds considerable "mass" or "inertia due to weight of fluid" to resist earthquake forces, discussed later.

IMPORTANT CONSTRUCTION FACTORS

Next to structural safety, a fundamental requirement, smooth deck surfaces and good railing appearance are probably the two most important factors to the motorist. Considerable care was taken, therefore, to insure good results in the completed structure, as follows:

(1) A railing and gutter profile was established for each side of the bridge, using long 1,400-foot vertical curves to give a smooth change of superelevation over the structure to fit approach alignment.

(2) Truss deflections due to full dead load were carefully computed, and elevations determined for each truss panel point to fit an "unloaded" profile. This "unloaded" profile is the final profile, plus the anticipated deflection under dead load.

(3) The fabricating shop subpunched, or sub-drilled, all main truss connections, then completely assembled each truss in a horizontal position in the shop, placing each top chord panel point in its correct relative position to fit the "unloaded" profile.

(4) All truss joints were then reamed to full size, and all members match-marked for erection.

(5) Trusses were then erected at the bridge site in any desired order as correct position was secured simply by jacking the trusses into shape until all truss connections were fair. No field drilling of these connections was allowed.

(6) The concrete deck was then poured in any order to suit the contractor's working schedule. This was an important feature, as pouring a deck slab uniformly from one end of a structure to the other is much less costly than requiring short individual pours over various parts of the bridge.

DECK IS "CUT LOOSE"

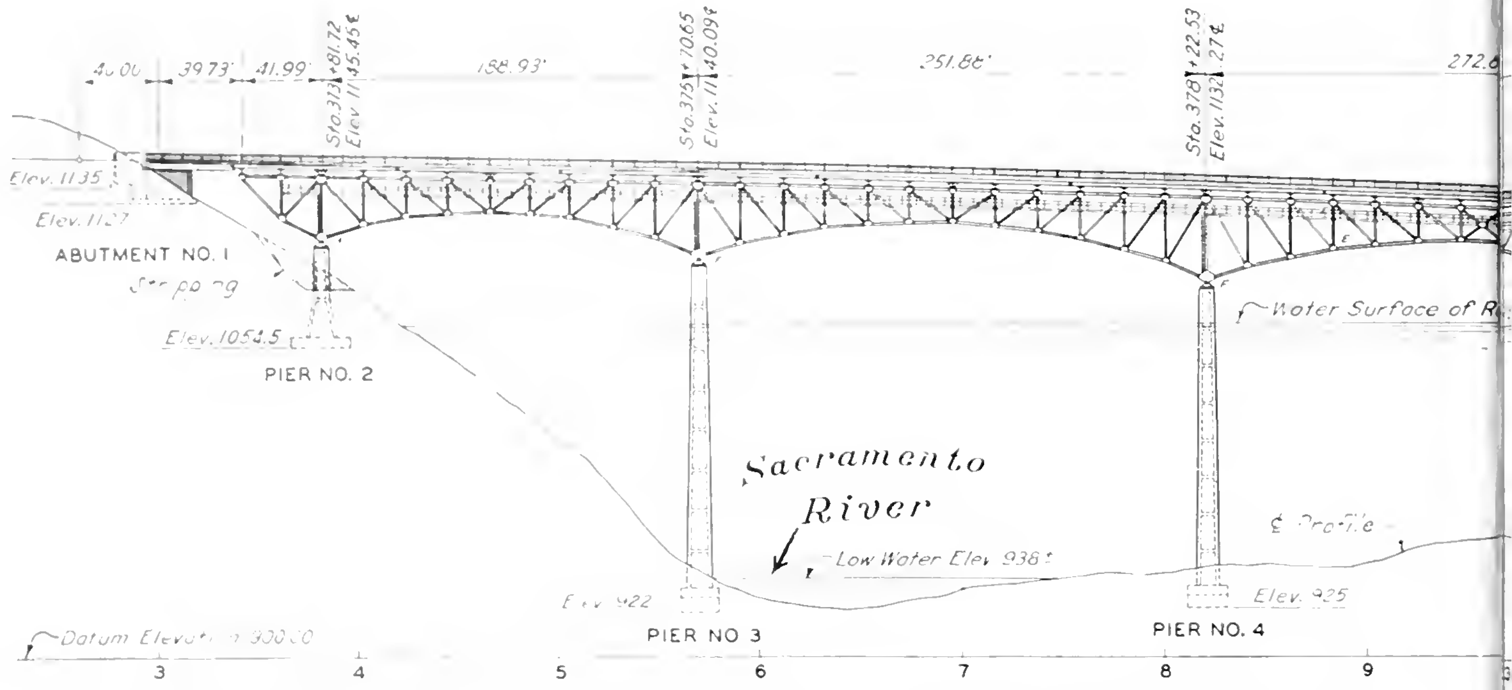
To prevent participation of the concrete deck slab in resisting stress set up in the trusses by the weight of the slab, as it would surely do if rigidly attached, the deck has been literally "cut loose" by introducing small expansion joints in the stringers approximately 100 feet apart. This is of no consequence to actual strength of truss members, but has a pronounced effect upon deflection of the trusses. As accurate truss-deflections can be determined only if the slab is prevented from taking direct stress, this procedure is essential to secure a smooth deck.

It is most important in constructing a concrete deck to anticipate accurately the deformation of the various members involved, as correcting a rough or wavy deck after construction is a difficult and costly process.

To eliminate deflection stresses from the piers, temporary expansion rollers were used at the tops of all piers. Upon completion of the deck slab and upon a suitable day of average temperature, the truss shoes were grouted into permanent position.

ROTATING TYPE JOINTS

Piers were arranged so that the four main piers on either side of the central span are supported longitudinally by anchor piers of comparatively low height located high up on



OUTLINE SKETCH OF 1,330-FOOT STEEL AND CONCRETE BRIDGE ACROSS SACRAMENTO RIVER CANYON AT ANTLER ON HIGHWAY RELOCATION AROUND SHASTA RESERVOIR SITE

the canyon walls. The main trusses are pin connected to the tops of all piers. A suspended span in the central 273-foot span, with provision for expansion at one end, establishes a symmetrical truss layout, continuous over three supports on each side of this span. Trusses are then fully "indeterminate" only over the center support of the group, the "degree of indeterminacy" diminishing toward the two outer supports of the group, becoming fully "determinate" at these supports and beyond.

In order to support the main piers in a longitudinal direction, the trusses were attached to the pier tops by a rotating type of joint that will transmit horizontal shear, but no bending movement. The elimination of a moment connection is important as a rigid type of connection would practically double the temperature stresses in trusses and piers set up by horizontal deflection of the piers.

Transversely, the four high piers must provide their own stability. No temperature stresses exist in this direction, but wind and earthquake forces are quite severe. Analysis of the effect of "wave action" of the reservoir water due to earthquake forces was made. This "wave action" effect refers to the oscillating motion set up by an earthquake, and should not be confused with surface "waves" due to wind or tide. Extensive research and model experimentation has been done in this field by the U. S. Reclamation Bureau at Denver, Colorado. The department is indebted to the Reclamation Bureau for the use of these studies.

TRUSSES BEND AROUND CURVE

Trusses were bent horizontally at two points between each pier rather than at the piers, to fit the horizontal curve of the bridge. A number of advantages result from this:

1. The eccentricity, or overhang, of deck stringers relative to the trusses is but one-fourth that produced by bending the trusses only at the piers. This eliminated additional steel in the floorbeams located between bend lines.

2. Bending moment in the truss is very low at the bend line due to the continuous truss layout. These bend lines occur at approximately the quarter points in the span where the dead load moments are practically zero.

Truss joint stresses are correspondingly low, and the torque resulting from these stresses is greatly reduced. While it is true that the torsional stresses set up at the bend lines must be transferred along the trusses to the piers, stresses are so low as to require no additional metal in the main trusses to resist them.

A newly developed alloy steel was used in the trusses, with 50 per cent greater tensile strength and five times as rust resisting as ordinary structural steel. Its excellent corrosive resistence permitted minimum sections of ¼-inch thickness, while the additional strength available resulted in large savings in weight of metal.

The truss member design represents a considerable departure from previous construction. All members consist of a 14-inch beam section, supplemented when necessary on the compression members with 15-inch or 18-inch channel sections shop welded to the beam flanges. No stay plates or lacing bars, formerly considered indispensable to truss members, were used. This not only reduces shop fabrication, but eliminates excess metal not directly participating in stress resistance.

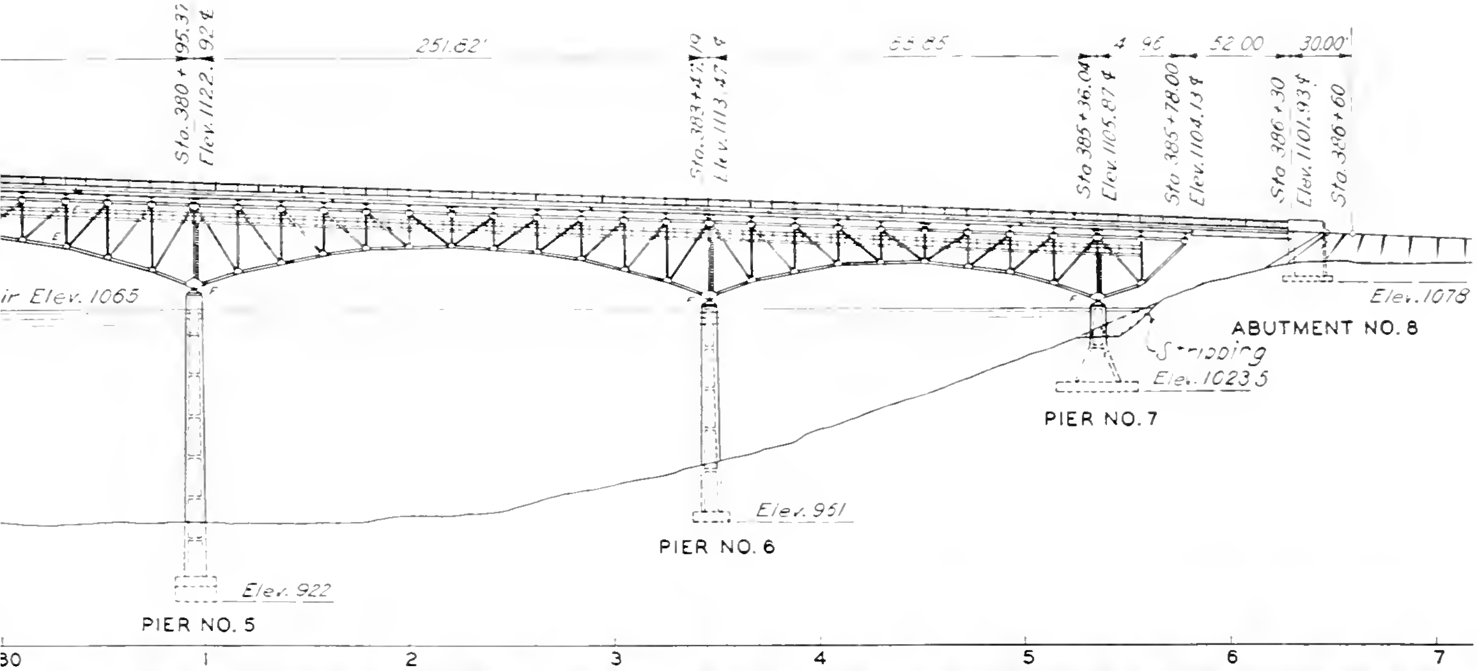
As truss members are perfectly smooth and accessible for painting, maintenance costs will be materially reduced.

ECONOMICAL "T" SECTIONS

Bracing members were made from structural tee sections obtained by splitting wide flange beam sections at the rolling mill when hot. These sections became available fairly recently and have proven very economical, reducing weight and eliminating shop fabrication.

Truss-shoes are built-up assemblies of rolled steel plate, shop-welded together to form a rigid unit. Alloy steel was used, resulting in a strength

(Continued on page 5)



View of 50-foot roadway of Antler Bridge built on 850-foot radius curve to carry relocated 4-lane divided highway

Relocation

ALL-YEAR YOSEMITE HIGHWAY IS NOW COMPLETED EAST OF MARIPOSA

By R. E. PIERCE, District Engineer

INDEPENDENCE DAY, 1941, saw traffic for the first time using the newly constructed relocation for 1.9 miles easterly from historic Mariposa. This change eliminates the last section of the original narrow, low standard alignment of the All-year Yosemite Highway, State Sign Route 140.

The following data indicates the great improvement made by this relocation.

	Old Route	New Route
Length, miles	2.103	1.945
Curves less than 500 ft. radius	1	0
Curvature, total degrees	2014 01'	349 43'

This makes a difference of more than 1664 degrees in favor of the new route, or nearly 5 complete circles; while the new route has less than 1 complete circle.

	Old Route	New Route
Total number of curves	37	8
Minimum radius	2–100	1–500
Roadbed width	21 ft.	28 ft.

Referring to the map, it will be seen that the resulting improvement was obtained by running northerly from Charles Street in Mariposa, thus avoiding the right angle turns imposed on the traveling public, due to following existing streets in the town.

The balance of the improved alignment is secured by more favorable topography and by some rather heavy grading.

In addition to shortening State Sign Route 140 by 0.158 mile, there is also a distance of 0.55 mile of State Sign Route 49 eliminated due to the new junction of the two routes about 0.5 mile north of Mariposa, instead of in the town as formerly.

This recent improvement of the All-year Yosemite Highway from Mariposa easterly was allotted $85,346. The contract was awarded on May 2, 1940, the date for completion falling on October 11, 1940. However, after the grading was completed and most of the rock surfacing was on the grade, the contractor abandoned the job, which was taken over by the bonding company.

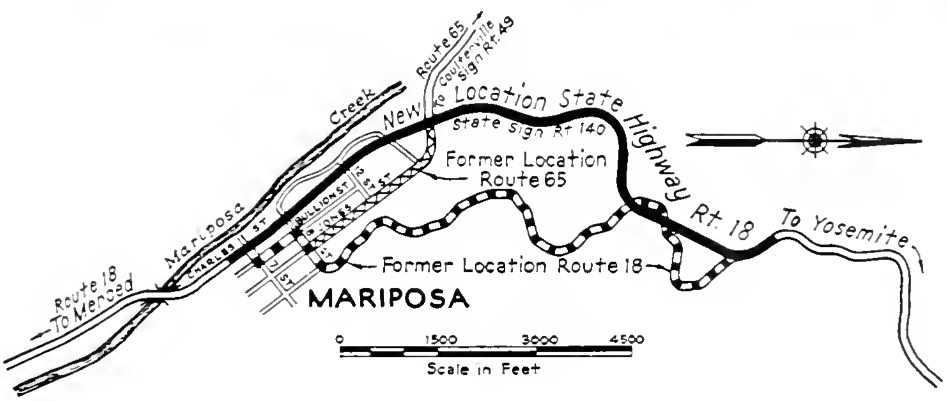
By this time, the rainy season had begun; hence the job was closed down and work was not resumed until May of this year.

New All-Year Yosemite Highway relocation goes straight through Mariposa obviating right hand turns of old route on city streets

Long, straight stretches characterize new highway which has only 8 curves compared to 37 on old route

The principal items in this contract were: 111,000 cubic yards of roadway excavation; 12,700 tons of gravel base; 5,800 tons of mineral aggregate (road mix surfacing), and 1,852 lineal feet of 8 to 48 inch corrugated metal pipe for culverts.

The Town of Mariposa founded during the "Gold Rush" period has a unique relic in its courthouse. Erected in 1852, it has been used continuously since that time for the same purpose, and is said to be the oldest courthouse in continuous use in California.



Highway Relocation Bridge Across Shasta Reservoir Site Completed

(Continued from page 2)

and ductility equal to that secured in the main truss. The largest truss shoe is approximately five feet square, 2½ feet high, and supports a load of more than 2,000,000 pounds.

Temperature variations of 20 to 120 degrees Fahrenheit produce a total movement of nine inches at the one expansion joint in the truss system. A sliding "finger" type of joint was used in the deck slab, featured by a locking device that anchors it rigidly to the deck to prevent noise and vibration due to passing vehicles. The joint is self-cleaning, in that rubbish and dirt can not collect in the openings, but are pushed off by movement of the bridge.

Construction was started on the substructure in March 1940, and was completed in October 1940. The steel erection was started in late September 1940 and was completed in February 1941. A total of 75 inches of rain fell during this period, greatly hampering the erection procedure.

The concrete roadway was completed early in June 1941 and shortly afterwards the contractors on the adjacent highway grading work were permitted to use the bridge. Public traffic will be routed over the new bridge upon completion of the surfacing on the new highway relocation.

The new structure with its 50-foot roadway replaces the old narrow concrete bridge at Pollock which had only a 21-foot roadway. Inasmuch as it

(Continued on page 7)

Los Angeles WILL GET NEW BUILDING TO HOUSE STATE HIGHWAY OFFICES

THE NEW State Building to be erected in Los Angeles, for which contracts were awarded by Director of Public Works Frank W. Clark July 19, will be located on the east side of Spring Street between First and Second Streets.

The building will be three stories in height with a full basement and a penthouse of considerable size rising above the central portion. Situated near the Civic Center, this building, designed by State Architect Anson Boyd, will be in character with the nearby buildings presenting a dignified, modernized-classical exterior.

"For many years," said Director Clark, "the Division of Highways has been in very cramped quarters in the present State Building and it has become necessary to erect a new building in order that the division may properly function. Under the terms of the contract, the building will have to be finished within 200 working days."

HOUSE THREE DIVISIONS

In addition to the Division of Highways, local offices of the Division of Architecture and Division of Water Resources of the Department of Public Works will occupy the new structure, together with offices for the director.

The Division of Highways will occupy the first and second floors and the two other divisions will be located on the third floor until such time in the future as the Highway Division may be obliged to again expand its quarters.

"Additional personnel of the legal staff of the Department of Public Works will also be accommodated in the new building," said Director Clark. "At the present time the greater portion of the legal work required by the Los Angeles Division of Highways district must of necessity be handled in our Sacramento headquarters. This does not add to the facility with which the department can conduct the tremendous amount of highway work in this section of the State.

CONFORMS WITH CITY PLAN

"In preparing the design for the new building, our architect engineers have made every effort to have the structure conform with the general civic center plan being developed by the City of Los Angeles. Governor Olson and I have endeavored to cooperate with the municipal authorities in making any new State Building fit in with the general civic center scheme.

"It was for this reason that a year ago we agreed to dispose of the site which had been secured for the new State Building on Bunker Hill between Hill and Olive Streets and Court and Temple Streets to an agency of the city government and instructed our division architect to prepare new plans for a building to be erected on the Spring Street site in close proximity to the City Hall."

SIMPLE AND PRACTICAL

A maximum of window areas with an economical column spacing is the State Architect's aim to be accomplished with simple materials and an avoidance of unnecessary detail. Pleasing concrete textures will take the place of elaborate mouldings and breaks.

From the entrance lobby of unusual interest to the penthouse structure, the building, with its 62,000 feet total area, has been planned for its practical functions.

In the basement is provided a small assembly room with a commission room adjoining. Like the rest of the building, this room is to be air conditioned and illuminated by fluorescent light. The remainder of the basement will be occupied by storage and file rooms, blue-printing department, and boiler and machine rooms. A freight elevator is off the service corridor and a service road running to it connects with an alley in rear.

From the entry on the first floor a vestibule serves the stairway to the assembly room and a telephone room for use of the public and contractors at bid openings.

The entrance lobby will have a terrazzo floor and marble steps. Elevator doors will be of figured capomo, an inexpensive hardwood from Mexico and Central America resembling bleached Honduras mahogany. The use of aluminum and stainless steel has been avoided due to the Government's need for these materials.

The public lobby leads off the elevator lobby with a counter and glassed information booth connecting to the permit engineers' space. A corridor leads from the lobby to the director's suite, consisting of a reception room, secretary's space with counter, director's office, assistant director's office, conference and committee room and foyer to the conference room, storage and washroom.

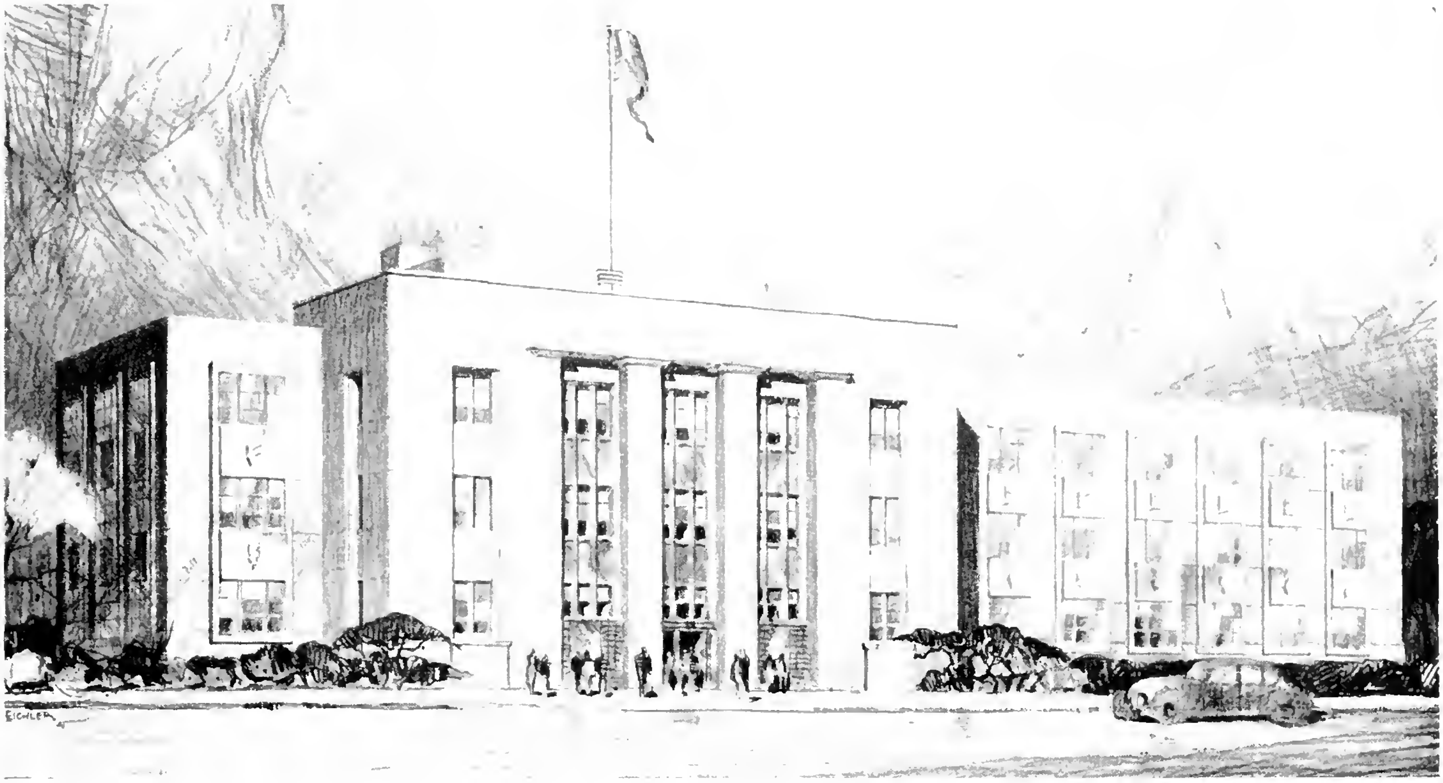
ACOUSTIC PROVISIONS

Down the corridor is also the maintenance engineer's and accounting department's pay roll and cashier's office and files.

Lavatories are located at the intersection of the corridors near the front lobby. Off the rear corridor is the testing laboratory and outdoor advertising office and offices of the hydraulic engineer, district materials engineer, city and cooperative projects, assistant office engineer and a large stenographic room. Ceilings of acoustical material will protect the building against noise and clatter.

On the second floor is a large elevator lobby and waiting room with counter for the general drafting room. Off this lobby a corridor connects to title search offices, and right of way department. The general drafting room occupies an entire wing of the building. Occupying portion of the east wing is the State Highway Engineer's offices and district engineer's offices, a reception room and secretary's office and offices of construction engineer's department, district office engineer, right of way agents, attorneys and a conference room.

The third floor houses the bridge department, traffic department, and Division of Water Resources, as well



New State Highway office building for Los Angeles designed by Division of Architecture of Department of Public Works

as the Architectural Division offices and a rest room.

In the penthouse, in addition to a recreation or assembly room, are elevator-machinery room, air-washer room and stairway which also leads to a roof deck. This space will provide a recreation area for the employees. It also connects to the rear stairway.

Provisions have been made for a fourth floor addition in the future, which can be anchored to the present building by uncovering the steel stubs on the roof and concrete poured to the desired height for an additional floor. The penthouse construction is such that it is removable and the boiler room chimney top and all can be moved up another story. The site provides ample space for future additions and this has been considered in the design of the building.

The planning is a result of devising a scheme which will be elastic, lending itself to changes in partitions from time to time. The Highway Department's special requirements developed the shape of the building. The requirements presented something of a problem as the function and interrelation of departments had to be carefully considered to insure convenience, efficiency and economy.

CODE FOLLOWED BY ROAD SIGN COLORS

Colors of road signs follow a definite code.

Warning signs are always yellow, except the advance railroad crossing sign, which is circular and white, with black letters. Yellow signs are of two types. Some are diamond shaped and used to indicate need for going slowly due to a permanent hazard, such as a curve, narrow bridge, grade, and similar conditions. Other yellow signs are rectangular and show need for proceeding with caution because of a cross road, slide area, school zone, and other possible but not necessarily constant hazards.

"Stop" signs are the only ones with a red background. Other regulatory signs and direction types are square or rectangular with black and white colors. U. S. route number signs are shield-shaped, the California route number signs are formed like an acorn.

United States and State route number signs are planned so that odd numbers represent the north-south routes and even the east-west.

Tourist: What a quaint little village! Truly one-half the world is ignorant of how the other half lives.

Native: Not in this village, mister, not in this village.

Highway Relocation Around Shasta Reservoir

(Continued from page 5)

will be inundated by the lake backed up by Shasta Dam, the old bridge at Pollock will be abandoned after traffic is routed over the new bridge with its deck 210 feet above the low water level of the lake.

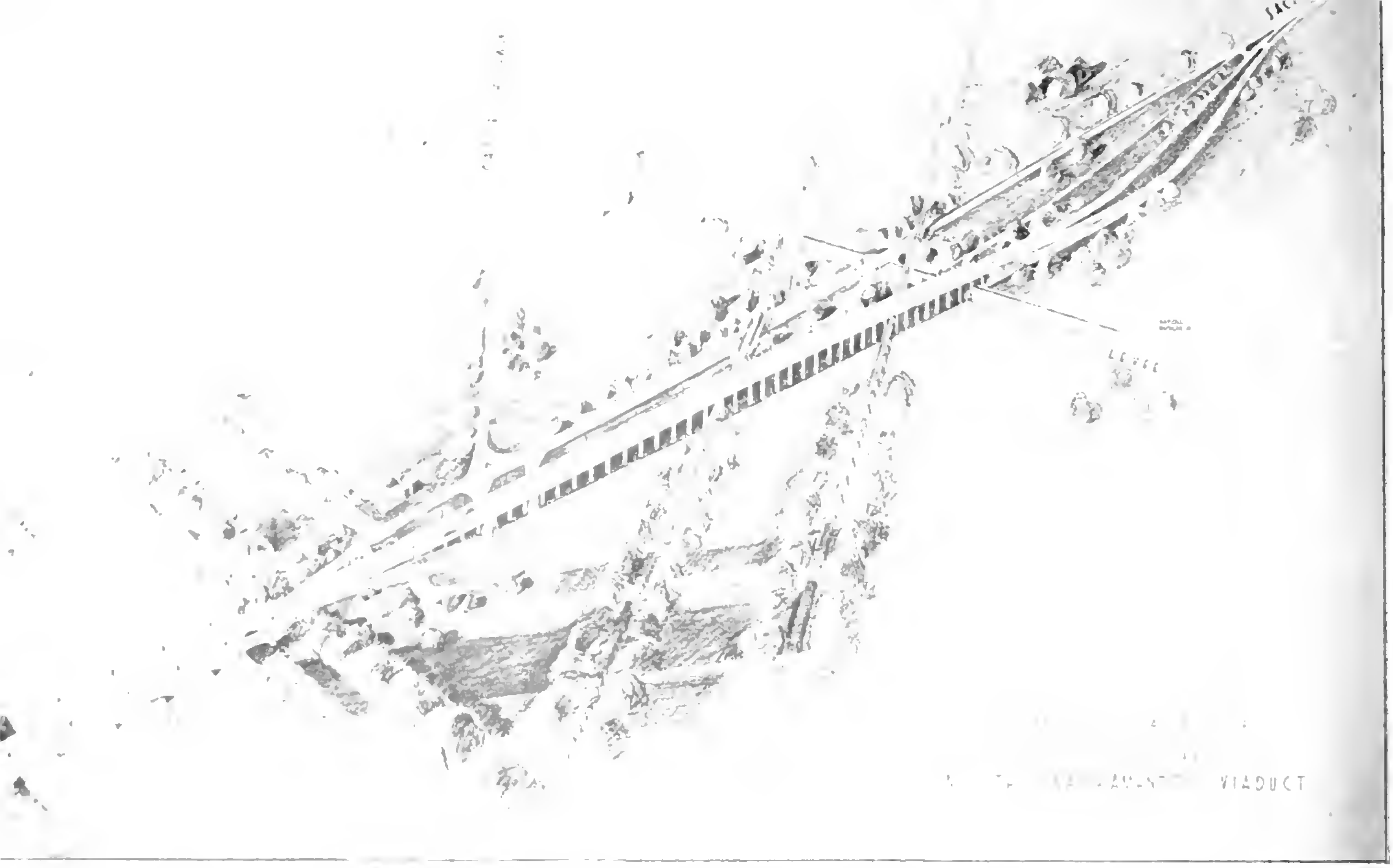
Telephone and telegraph cables are carried across the bridge under the roadway deck.

Mr. Charles R. Poppe is Resident Engineer for the State on this project. The structure was designed by the Bridge Department under the direction of the writer, L. C. Hollister, Design Engineer and Glenn L. Enke, Associate Bridge Engineer.

The United Concrete Pipe Corporation of Los Angeles was the contractor, having been awarded the contract by Director of Public Works Frank W. Clark on their bid of $672,046, the lowest of seven bids received.

Young Father—In your sermon this morning you spoke about a baby being a new wave on the ocean of life.

Minister—That's right. Do you think a fresh squall would have been more correct?



Sketch of 1,496-foot viaduct for 4-lane highway now under construction across American River overflow between Sacramento and North Sacramento

Viaduct

GROUND-BREAKING STARTS CONSTRUCTION ACROSS THE AMERICAN RIVER OVERFLOW

CONSTRUCTION of the half million dollar viaduct across the American River connecting Sacramento and North Sacramento was begun July 8 following ground-breaking ceremonies held at the easterly end of the project.

A program of speech making, participated in by Sacramento County and City and North Sacramento officials, the U. S. Army, and representatives of chambers of commerce and civic organizations of both cities, preceded the turning of the first spadeful of earth by Director of Public Works Frank W. Clark. Immediately following that event the contractor, Earl W. Heple, of San Jose, who will construct the viaduct at a cost of $528,136, set heavy equipment to work on the project.

Secretary of State Paul Peek, represented Governor Culbert L. Olson, and Captain M. P. Hart of McClellan Field, representing Lt. Colonel John W. Clark, spoke for the Army. Captain Hart said that McClellan Field was particularly interested in the viaduct because it would constitute an important unit in the West Coast National Defense Program.

Other speakers were Assemblyman Edward J. Cain of Sacramento, who made the opening address; Mayor Tom B. Monk of Sacramento; Mayor Elwood Miller of North Sacramento; President William Rutherford of the North Sacramento Chamber of Commerce; Dr. R. N. S. Cook, President of the Sacramento Chamber of Commerce; and Clarence Champlin, Sacramento Board of Supervisors.

The proposed project will make a true all-year highway north on Route U. S. 99 and east on U. S. 40, as well as between the two cities by obviating the necessity of closing the road at times each winter due to flooding by overflow waters of the American River.

The new structure will start about 300 feet north of the American River bridge and will rise by easy vertical curves at a maximum rate of 6.2 per cent to a height of more than 50 feet above ground.

It will clear the railroad trestle by 28 feet to provide for future raising of the tracks, which are now below the extreme flood plane established by the State Reclamation Board engineers.

Connections will be made at the end of the American River bridge and at the south limits of North Sacramento. An off-ramp connection will be made to the Garden Highway and bottom lands passing under the structure so that cars will not have to cross opposing traffic.

The viaduct will be of reinforced concrete with the exception of the steel railing and expansion details. It will be 1,496 feet long, consisting of 36 spans each 41 feet long with 10-foot cantilever spans at each end of the bridge.

The bridge deck will have an over-all width of 65 feet, consisting of a 6½-inch slab supported on 11 shallow girders each one foot wide. The depth of the superstructure will be only 3 feet 8 inches, which was an important consideration in providing clearance for the railroads with a minimum rise.

The viaduct will provide four traffic lanes on two 25-foot roadways, separated by a 4-foot dividing strip and in addition two sidewalks each 4 feet wide. An open type steel railing will permit an unobstructed view from the deck and harmonize with the structural features of the bridge. The deck will be lighted by 20 incandescent luminaires.

Approximately one year will be required to complete the structure and approach work.

In the first two months of 1941 legislative sessions in the New England states, 825 bills were introduced affecting highway users and the highway transportation industry. Connecticut led with 320; Massachusetts, 261; Maine, 117; New Hampshire, 58; Vermont, 37; Rhode Island, 32.

Weekly incomes of more than half the car owners in the United States are less than $30 in normal times, states the American Petroleum Institute. Almost three-quarters of all the car owners have incomes of less than $40. Only 12 per cent have an income of more than $60 a week.

Director Frank W. Clark breaks ground for new viaduct, assisted by Assemblyman E. J. Cain (left) and Secretary of State Paul Peek

Argentina Highway Network Will Cost $225,000,000

Argentina plans an improved network of roadways which will form an important part of the International Pacific Highway which is to extend eventually from Fairbanks, Alaska, to Buenos Aires.

Advices received by the Automobile Club of Southern California state that the National Roads Board of Argentina has submitted to the federal government a program involving a national outlay of 900 million pesos ($225,000,000). This sum, which will be expended over a period of 14 years, represents an increase of 585 million pesos over the originally announced plan.

Preference will be given to appropriations for roads linking Argentina with its neighboring republics. The new program allocates 45 million pesos for completion of the route connecting Argentina with northern Bolivia; 41 million pesos for a road from Buenos Aires to Mendoza and the Chilean border; and 27 million pesos for a highway through the Chaco to Clorinda, opposite the Paraguayan capital of Asuncion.

Also planned are widespread road construction and improvements in the southern territories of Argentina, as well as important inter-provincial roads. The plan contemplates an expenditure of 354,521,284 pesos ($88,315,160) in the federal capital and Buenos Aires province.

274 Billion Miles On Necessity Trips

Authoritative figures recently compiled show that 96 per cent of the passenger automobiles in use in the United States are engaged in necessity driving. Private owners drove 274 billion miles on 15 billion necessary trips in 1940—mileage more than ten times that of any other form of transport, and over five times that of electric and steam trains, buses, and airlines combined.

Over half the year's total automobile mileage, and in excess of three-fourths of the individual trips, were for purposes connected with earning a livelihood or closely related economic pursuits, surveys disclose.

Realignment

REDUCES GRADES AND CURVES ON 101 SOUTH OF SAN LUIS OBISPO

By E. J. L. PETERSON, District Office Engineer

WORK is under way on the realignment of the Coast Highway U. S. 101 in San Luis Obispo County, at Miles Station halfway between San Luis Obispo and Pismo Beach.

The new alignment includes elimination of the present narrow posted bridge over the San Luis Obispo Creek and replacement of a section of poor alignment and grades where the accident rate is comparatively high.

The volume of traffic over this section varies from 4,000 to 7,500 vehicles per day. During the summer months, on holidays and week ends, when there is a particularly large volume of recreational traffic, the volume has been found to exceed 10,000 vehicles per day.

The following tabulation will indicate a comparison of the standards of the old with the new highway:

	Old Highway	New Highway
Number of curves (1,000 foot radius or less)	4	0
Minimum radius	600 feet	1500 feet
Total curvature	250 degrees 15 min.	126 degrees 32 min
Maximum grades	6%	4.78
Length	1.668 miles	1.489 miles

The saving in distance is 0.179 Miles.

This project is one and one-half miles in length and consists in general of constructing a reinforced concrete bridge with a 26-foot roadway over San Luis Obispo Creek and grading a 36-foot roadbed and placing plant-mixed surfacing 22 feet wide by 0.25 foot thick. The surfacing is placed on a crushed rock base 6 inches thick over the full width of the roadbed with 1.25-foot selected material sub-base. The 7-foot shoulders will receive a Class "B" seal coat.

The improvement was divided into two parts, contracts being let in August 1940, one for the bridge construction, awarded to Dan Caputo of San Jose, California, and the other for the road construction let to Gibbons & Reed of Burbank, California.

The new location lies easterly of the present road and, where San Luis Obispo and Ontario Creeks are crossed, the old channels had been filled with soft black sand, a black and blue peaty clay having a moisture content of 10 to 60 per cent and varying in depth from 10 to 70 feet.

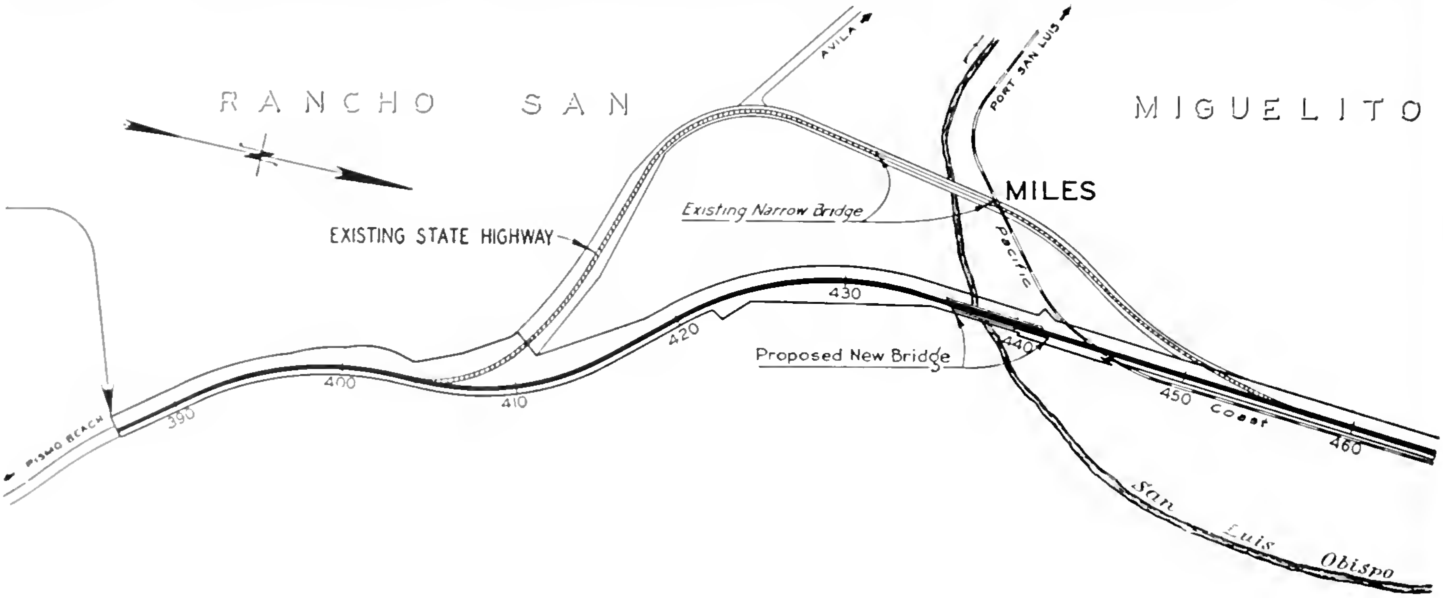
These areas required special foundation treatment to support the superimposed loads to be placed thereon by the highway embankments which vary up to 70 feet in height. Stabilization of the foundations at these locations was accomplished by constructing vertical sand drains to permit the escape of ground water as pressure was applied to the surface in placing the embankment.

At San Luis Obispo Creek 22,700 lineal feet of drains were constructed by drilling wells 26 inches in diameter through the clay formation, varying in depth from 8 feet to 68 feet spaced on 14-foot centers parallel to centerline and 10-foot centers at right angles to centerline.

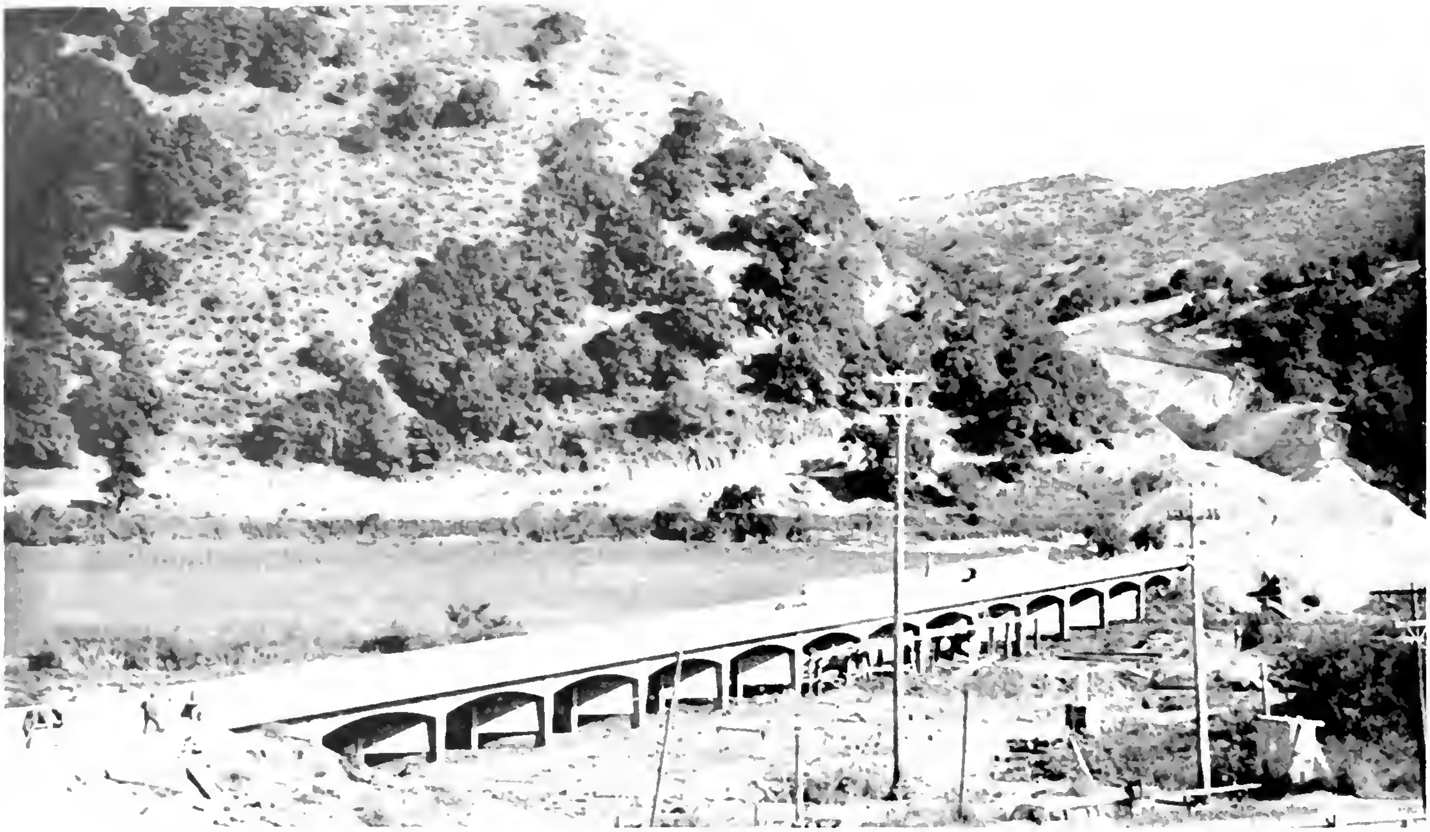
At Ontario Creek 20,000 lineal feet of drains were constructed by drilling wells 18 inches in diameter varying in depth from 10 feet to 55 feet, spaced on 12-foot centers parallel to centerline and at right angles to centerline.

The material excavated from the drains was removed from the embankment areas and placed immediately adjacent to the fills as toe support.

In order to clean the wells of sediment before backfilling, clear water was pumped into the wells and removed by suction pump which carried away the silt and sediment.



Scenes on realignment construction of U. S. 101 south of San Luis Obispo. Top picture shows bridge being built and rough grading near San Luis Obispo Creek. Below—White line indicates new route compared with existing grade



New concrete bridge over San Luis Obispo Creek is 570 feet long with 26-foot roadway supported on 15 piles

This process was continued until all the sediment was removed after which the wells were backfilled with clean sand.

SAND BLANKET PLACED

A 2-foot sand blanket was placed over the entire area to provide a drainage outlet from the sand drains.

In order to permit consolidation of the foundation material and to obviate lateral displacement, the embankments were placed in uniform layers to a maximum height of 5 feet in any one week. Upon completion the embankments were overloaded to an average height of 8 feet.

Existing bridge is an old, narrow through-truss steel structure

This overload was permitted to remain in place for a period [illegible] three months after which [illegible] was removed and used to [illegible] fill slopes, except for the embankment at Ontario Creek where the over[illegible] material consisted of the base [illegible] which was stockpiled on the top of the embankment.

The mineral aggregate for the base rock is being obtained by crushing the harder shale in a cut near the [illegible] end of the project.

The total cost of the project is [illegible] at approximately $250,000.

The Resident Engineers for the State are U. J. Ele, for the bridge and V. E. Pearson for the road construction.

She: "Henry, dear, we've been going together now for more than ten years. Don't you think we ought to get married?"

He: "Yes, you're right—but who'll have us?"

Pavement CONSTRUCTION DEPARTMENT PRESENTS REPORT ON RECORDS AND PROGRESS IN 1940

Publication of the following annual report by the Construction Department of the Division of Highways, giving details of pavement construction in 1940, is eagerly awaited both by contractors and State engineers connected with the various projects, who evince a keen competitive interest in the records of average daily concrete yardage, strength per square inch, per cent variation in cement control, asphalt tonnage, and roughness index per mile.

By EARL WITHYCOMBE, Assistant Construction Engineer

THE WINTER of 1940-1941 was the most severe from the standpoint of rainfall that California has experienced for the past 50 years or more. As a result of this severe wet season failures in the older pavements have been accelerated but it is noted with considerable satisfaction that the more recent construction is comparatively free from distress from this cause.

Without question, the corrective measures taken in planning and during construction to overcome the inherent weaknesses in the support afforded the roadbed by the underlying native soils have in a large measure been responsible for the effectiveness of the later pavements. It would appear that the large expenditures made for the importation of selected soils or gravels to blanket unsatisfactory soils and build up the pavement subgrades are returning large dividends both in the reduction of maintenance and in the uninterrupted use of the highways by the traveling public.

Automatic proportioning has proved sufficiently successful to continue to use it in the new Standard Specifications for both asphalt concrete and Portland cement concrete pavement. This requirement is mandatory on all but small projects involving less than 3,000 tons of asphalt concrete or 1,500 cubic yards of Portland cement concrete.

PORTLAND CEMENT CONCRETE

Construction Methods

During 1940 little change was made in the methods of proportioning or laying of concrete pavements from those in use during the previous year.

Of the 21 projects constructed, 20 were of Class "B" concrete design, using five sacks of cement to the cubic yard, and only one project was of Class "A" with six sacks. A finer grading of fine aggregate has been designed for use in 5-sack concrete to improve its workability. Bulk cement was little used in the season's work.

Expansion joints three-quarters inch thick are generally placed at 120-foot intervals, with intermediate weakened plane joints. The former practice was to place weakened plane joints at 20-foot intervals, but this is now being shortened to 15 feet.

Redwood board is now being commonly used for expansion joint filler where climatic conditions are not too severe. The redwood is specially selected, clear, light-weight material with a requirement that the oven-dry weight shall not exceed 25 pounds per cubic foot.

The use of Portland cement concrete as a base course for a bituminous top was somewhat extensive on city projects during the past season, 5-sack concrete being generally used for these bases.

Construction Records

The maximum *average daily output* for Portland cement concrete pavement per 8-hour day was on Contract No. 27XC3, road VII-L.A-175-A, Main Street to Central Avenue. Oswald Brothers, the Contractors, averaged 462.7 cubic yards per day, with W. D. Eaton as Resident Engineer, and C. J. McCullough, Street Assistant. The average daily output for the entire State during 1940 was 374.3 cubic yards compared to 381 cubic yards in 1939.

The *average compressive strength* of Class "B" (5-sack) concrete at 28 days was 4,204 pounds per square inch in 1940, compared to 3,740 pounds in 1939, an increase of 12.4%. Only one contract had Class "A" concrete, being a PWA project on Olympic Boulevard, VII-L.A-173-L.A, which had an average compressive strength of 4,100 pounds.

The highest average compressive strength during 1940 was 4,915 pounds for Class "B" concrete on Contract No. 211VC1, road XI-S.D-12-LMsa,B,ECj, on El Cajon Avenue, La Mesa to Sunshine Street, V. R. Dennis Construction Company, Contractor, L. H. Williams, Resident Engineer, and B. F. Moore, Street Assistant.

The record for *cement control* was made on Contract 011GC1, road XI-S.D-S.D, Washington Street, 5th Avenue to 9th Avenue, where the average variation was 0.3%. V. R. Dennis Construction Company was also the Contractor on this project, with C. R. Hagberg, Resident Engineer, and L. B. Munro, Street Assistant. The average variation for the State during 1940 was 0.93%, compared to 0.58% in 1939.

The record for *surface smoothness* was made on Contract 211VC1, above referred to, with an average roughness index of but 4.1 inches per mile. The average smoothness for the State in 1940 was 7.4 inches per mile, compared to 5.8 inches for 1939.

ASPHALT CONCRETE

Construction Methods

All of the 1940 season's work was laid with asphalt having a penetra-

(Continued on page 16)

Sepulveda Boulevard in Los Angeles has two 17-foot lanes of asphaltic concrete and two 12-foot lanes of Portland cement concrete

PORTLAND CEMENT CONCRETE PAVEMENT RECORDS FOR 1940

Location	Contractor	Resident Engineer	Street Assistant	Average cu. yds. laid per 8-hour day	Average strength, 28 days, lbs. per sq. in.	Per cent average daily variation in cement	Roughness index inches per mile
Route 5—Santa Clara St.	A. J. Raisch and Earl W. Heple	H. S. Payson	G. L. Beckwith	457.3	3542	0.53	7.3
At El Camino Real and University Ave.	Union Paving Co.	H. S. Payson	H. A. Hart	217.5	4495	.80	10.9
Lake St.—Golden Gate Bridge Approach	Union Paving Co.	T. E. Ferneau	H. A. Hart	244.6	4170	1.33	6.9
Santa Ana River Bridge Approach	Vido Kovacevich	B. N. Frykland	H. D. Johnson	256.4	4303	.41	6.8
E. Third St., Indiana St.—Repetto St.	State Forces (WPA)	F. B. Cressy	M. A. Wood	435.0	3950	.55	17.7
Sepulveda Blvd., Gamut Pl.—Ventura Blvd.	Griffith Company	E. L. Seitz	E. C. Daniels	441.4	4368	1.51	11.7
Olympic Blvd., Beverly Glen Blvd.—Pontius Ave.	Basich Bros.	E. A. Parker	A. W. Carr	369.1	3835	1.01	4.6
Arroyo Seco Pkwy., Ave. 58—Fairfield Ave.	Radich & Brown	R. J. Hatfield	C. L. Aisthorpe	430.9	4148	.55	13.0
El Modena Ave., Colorado Blvd., N. Figueroa St., and La Loma Rd.	Claude Fisher Co.	C. P. Montgomery	C. L. Gildersleeve	312.9	4745	1.56	16.3
Olympic Blvd., Pontius Ave.—Bundy Dr.	Basich Bros.	E. A. Parker	R. E. Deffebach	452.7	4100	---	5.6
Arroyo Seco Pkwy., Ave. 40—Ave. 50	J. E. Haddock	R. J. Hatfield	H. D. Johnson	448.8	3974	.31	9.9
Arroyo Seco Pkwy., Ave. 26—Ave. 22	J. E. Haddock	R. D. Thorson	R. Deffebach	358.8	4330	1.27	6.1
Arroyo Seco Pkwy., Ave. 35—Ave. 40	Nick Perscallo	G. E. Farnsworth	R. E. DeGroff	371.4	4392	.65	6.0
Arroyo Seco Pkwy., Ave. 35—Ave. 25	J. E. Haddock	R. D. Thorson	R. Deffebach	263.0	4355	1.50	7.7
Main St.—Central Ave.	Oswald Bros.	W. D. Eaton	C. J. McCullough	462.7	3893	.80	10.2
Arroyo Seco Pkwy., Grand Ave.—Fair Oaks Ave.	Griffith Company	C. P. Montgomery	H. D. Johnson	307.4	4493	.40	5.6
Los Angeles County Line—Timber School	Griffith Company	F. A. Read	W. T. Lamb	392.3	3825	1.19	4.8
Merced—Black Rascal Creek	Marshall Hanrahan	A. N. Lund	E. D. Bulton	383.7	4265	1.00	6.0
South Approach, Turlock Overhead Xing	Union Paving Co.	J. C. Witherell	R. K. Wells	135.5	4415	1.21	6.8
El Cajon Ave., La Mesa—Sunshine St.	V. R. Dennis Const. Co.	L. H. Williams	B. F. Moore	406.2	4915	.70	4.1
Washington St., 5th Ave.—9th Ave.	V. R. Dennis Const. Co.	C. R. Hagberg	L. B. Munro	165.9	3305	.30	12.5
			Averages	374.3	4204	0.93	7.4

ASPHALT CONCRETE PAVEMENT RECORDS FOR 1940

Location	Contractor	Resident Engineer	Street Assistant	Average tonnage laid per day	Average stability of surface mixture in %	Average relative gravity of surface mixture in %	Roughometer index, inches per mile
Route 5—Santa Clara Street	A. J. Raisch and Earl W. Heple	H. S. Payson	H. A. Hart	420.6	37.3	95.6	11.5
At El Camino Real and University Ave.	Union Paving Co.	H. S. Payson	G. L. Beckwith	470.9	47.1	93.3	19.4
Proberta—Red Bluff	Piazza & Huntley and J. P. Brennan	M. Fredericksen	R. L. Barkwell	698.7	37.9	89.5	13.1
Arcola School—Madera	Piazza & Huntley and Trewhitt-Shields	F. W. Howard	F. B. England	724.8	44.0	92.7	8.1
Kingsburg—1.9 mi. Southerly	Piazza & Huntley	F. W. Howard	L. Tresidder	663.8	40.2	91.6	12.4
Highway School—Visalia	Piazza & Huntley	C. F. Oliphant	P. A. Boulton	700.3	41.0	93.8	10.4
Lincoln Blvd.—Venice Blvd., Santa Monica	Griffith Company	C. N. Ainley	A. W. Carr	503.7	31.2	94.8	15.9
Pico Blvd.—Bicknell Ave.	Oswald Bros.	H. J. Fallai	R. C. Porter	265.0	36.0	94.5	21.1
Sepulveda Blvd., Gamut Pl.—Brand Blvd.	Oswald Bros.	E. L. Seitz	R. Malone	574.3	32.0	95.3	25.4
Sepulveda Blvd., Gamut Pl.—Ventura Blvd.	Griffith Company	E. L. Seitz	P. F. Green	579.3	35.0	92.6	13.4
Olympic Blvd., Beverly Glen Blvd.—Pontius Ave.	Basich Bros.	E. A. Parker	A. W. Carr	402.6	33.0	93.5	15.6
Arroyo Seco Pkwy., Ave. 58—Fairview Ave.	Radich & Brown	R. J. Hatfield	H. J. Fallai	419.0	39.3	92.0	15.4
El Modena Ave., Colorado Blvd., N. Figueroa St., La Loma Rd.	Claude Fisher	C. P. Montgomery	C. E. Abbott	382.6	---	92.0	19.1
Colorado Blvd., El Modena Ave.—Townsend Ave.	C. H. Johnston	C. P. Montgomery	Ed Delancy	552.5	---	---	23.9
Olympic Blvd., Pontius Ave.—Bundy Dr.	Basich Bros.	E. A. Parker	A. W. Carr	626.4	---	---	14.9
Arroyo Seco Pkwy., Ave. 40—Ave. 50	J. E. Haddock	R. J. Hatfield	R. E. Schott	547.2	36.0	92.8	11.5
Colorado Blvd., Maywood Ave.—Broadway	Oswald Bros.	F. A. Read	J. R. Rubey	416.7	---	---	31.1
Arroyo Seco Pkwy., Ave. 35—Ave. 40	Nick Perscallo	G. E. Farnsworth	V. O. Sheff	470.2	38.8	93.9	17.1
Arroyo Seco Pkwy., Ave. 35—Ave. 26	J. E. Haddock	R. D. Thorson	R. E. Schott	486.7	47.0	91.4	14.5
Arroyo Seco Pkwy., Ave. 26—Ave. 22	J. E. Haddock	R. D. Thorson	R. E. Schott	461.0	43.0	94.2	12.9
Main St.—Central Ave.	Oswald Bros.	W. D. Eaton	C. J. McCullough	558.2	39.0	94.4	16.3
Arroyo Seco Pkwy., Grand Ave.—Fair Oaks Ave.	J. E. Haddock	C. P. Montgomery	H. D. Johnson	504.4	31.0	---	18.5
South Approach, Turlock Overhead Xing	Union Paving Co.	J. C. Witherell	R. H. Wells	105.9	29.0	---	20.3
On N. Wilson Way	S. M. McGaw	E. L. Craun		380.5	12.0	94.3	84.0
El Cajon Ave., La Mesa—Sunshine St.	V. R. Dennis Const. Co.	L. H. Williams	C. R. Hagberg	611.4	38.2	92.4	23.3
Rosecrans St., Lytton St.—Canon St.	Griffith Company	R. C. Payne	S. M. Templeton	643.7	41.7	92.5	16.7
Barnett Ave. and Rosecrans St., Miramar Rd.—Torrey Pines Reservoir	R. E. Hazard	F. D. Pearce	J. F. Jorgensen	331.8	42.0	93.3	26.1
			Averages	541.0	37.4	93.0	14.9

U. S. 50 realignment east of Folsom paved with plant-mix surfacing in 22- and 23-foot widths

BITUMINOUS TREATED SURFACES—RECORDS FOR 1940

Plant Mix

Location	Contractor	Resident Engineer	Roughness Index Inches per mile
Crawford Ranch—Ukiah	Fredericksen & Westbrook	C. M. Butts	44.2
Outlook Creek—Reeves Creek	Marshall Hanrahan	C. M. Butts	41.9
Stronghold—Oregon State Line	Harms Bros. and N. M. Ball Sons	G. Sundman	56.6
3.7 mi. N. of Rush Creek Bridge—Pit River	Harms Bros. and N. M. Ball Sons	H. K. Ward	36.3
Red Bluff—6 mi. N.	Jones & King	E. J. Peterson	13.4
Central Valley—Shasta Summit	Jones & King	H. B. Milner	9.3
At Berg and Lomo	Hemstreet & Bell	R. I. Nicholson	40.3
4 mi. S. of Fagan—Biggs Rd.	Piazza & Huntley	J. C. Womack	21.2
3.7 mi. E. of Folsom—2½ mi. E. of Clarksville	Hemstreet & Bell	J. W. Corvin	24.8
1.5 mi. S.—1.5 mi. N. of Rattlesnake Creek	Hemstreet & Bell	W. G. Remington	58.0
Pine Creek—Sugar Creek	Claude C. Wood	F. E. Wilson	20.8
Hampshire Rocks—Soda Springs	J. R. Reeves	W. G. Remington	13.8
2.7 mi. E. of Williams—Colusa	Hemstreet & Bell	H. O. Ragan	26.9
Isleton—Walnut Grove	Jones & King	H. O. Ragan	24.6
Oaks Road—Los Gatos	Heafey-Moore & Frederickson-Watson Co.	A. Walsh	23.8
Myrtle Ave., San Rafael—San Quentin Wye	Chas. L. Harney	W. A. Rice	14.4
Near Wyatt's Cor. and Yenni Ranch—0.6 mi. E. of County Line	E. A. Forde	E. Carlstad	19.0
2.5 mi. N. of Cloverdale	Heafey-Moore & Frederickson-Watson Co.	E. W. Heberling	27.5
Niles—Farwell	Piombo Bros. & Co.	F. W. Montell	30.2
Saratoga—Los Gatos	Caputo & Keeble	A. Walsh	23.5
Southerly Boundary—Bradley	Hemstreet & Bell	V. E. Pearson	12.1
2 mi. S.—3 mi. N. of Greenfield	Jones & King	F. C. Weigel	21.6
Jonata Park—Zaca	Guerin Bros.	H. J. Doggart	13.1
0.5 mi. E. of El Capitan Creek—Orella	R. E. Hazard & C. Crow	J. C. Adams	8.9
San Juan Rd., 2.2 mi. E.—4.9 mi E. of Pajaro	Granite Construction Co.	H. J. Doggart	16.0
Route 143—Sivert	Basich Bros.	D. G. Evans	25.1
At Firebaugh	A. Teichert & Son	R. Windele	17.4
Placerita Canyon—Solamint	N. M. Ball Sons	M. L. Bauders	26.7
Brent's Junction—Liberty Grade	J. E. Haddock	E. L. Seitz	26.5
Los Angeles County Line—Timber School	Griffith Company	F. A. Read	16.7
San Juan Capistrano—0.5 mi. E.	A. S. Vinnel & Co.	C. L. Gildersleeve	13.2
E. Third St., Indiana St.—Repetto St.	State Forces (WPA)	F. B. Cressey	61.9
Rosamond—Mojave	R. E. Hazard & Sons	C. M. Rose	11.7
9 mi. N. of Lone Pine—Independence	Basich Bros.	F. R. Pracht	10.9
Olancha—Cottonwood Creek	Basich Bros.	F. R. Pracht	14.2
Mojave—Ricardo—4.5 mi. W. (Por)	G. W. Ellis	C. M. Rose	13.0
1.7 mi.—2.5 mi. E. of Valley Springs	L. Biasotti & Son	A. K. Nulty	5.7
1 mi. S. of Jackson Creek—2 mi. S. of Ione	Fredericksen & Westbrook	A. K. Nulty	6.1
Ione—2 mi. S.	Fredericksen & Westbrook	A. K. Nulty	5.8

Road Mix

Location	Contractor	Resident Engineer	Roughness Index Inches per mile
4 mi. N. of Lake City—Ft. Bidwell	Poulos & McEwen	H. B. Milner	41.5
Cedarville—4.6 mi. S.	Harms Bros.	B. Barry	20.1
Lake Leavitt—Rager's Corner	Isbell Construction Co.	C. A. Potter	21.7
2 mi. E. of Phillips—3 mi. W. of Meyers	Lee J. Immel	R. I. Nicholson	23.6
Butte City—Cherokee Canal	Oilfields Trucking Co.	R. E. Nicholson	69.7
Yosemite National Park—Lake Ellery	Isbell Construction Co.	J. N. Stanley	61.1
3.3 mi. S. of Poso Creek—Poso Creek	George E. France	D. G. Evans	33.0
At Norco	Matich Bros.	E. A. Bannister	16.5
Mt. Andreson—Crestline	Matich Bros.	E. A. Bannister	34.1
Big Pine Airport—Big Pine	Basich Bros.	F. R. Pracht	12.9
At Grant Lake	Isbell Construction Co.	J. N. Stanley	118.4
West Walker River—Route 23	Basich Bros.	H. F. Caten	50.2
1.7 mi. S.—6.7 mi. S. of Shoshone	Roland T. Reynolds	F. R. Pracht	23.7
3 mi. W. of Blythe—Ash St., Blythe	Daley Corporation	F. D. Pearce	93.1
Donner Summit—2 mi. Easterly	Fredericksen & Westbrook	E. L. Miller	106.7
		Average	49.2

(Continued from page 13)

tion greater than 70. For the interior valleys, the tendency has been to hold the penetration down to the minimum permissible.

The use of a coarser sand and less filler dust than was formerly the practice has given a mixture that is considerably easier to manipulate. This, coupled with the general use of lesser amounts of sand, has resulted in a surface of considerably more open texture, which adds to the safety feature of its riding qualities.

The open texture surfaces are more difficult to hold intact in adverse weather and the light application of emulsified asphalt seal coat becomes more important. An application of not to exceed one-quarter gallon per square yard of surface is specified,

Colorado Blvd. Divided Highway in Los Angeles County paved with 2-inch asphaltic concrete on 6-inch Portland cement concrete base

but rarely exceeds one-sixth gallon. On the closer textures, this has been reduced to one-twelfth gallon by using the mixing type emulsion and cutting back with equal parts of water. Very uniform applications have been made with the use of atomizing sprays. No cover is used on this type of seal and traffic is permitted to use the road soon after application.

Construction Records

The highest *average daily output* of asphalt pavement tonnage was placed on Contract 26TC1, VI-Mad-4-A, between Areola School and Madera where about 725 tons were placed by Piazza-Huntley and Trewhitt-Shields, Contractor; F. W. Howard was Resident Engineer, and F. B. England, Street Assistant. The average daily output for the entire State was 541 tons in 1940, compared to 561.8 tons in 1939.

The highest *stability of surface mixture* was obtained on Contract 24TC3, IV-SC1-2-A,PA, with an average of 47.1%, Union Paving Company being the Contractor, H. S. Payson, Resident Engineer, and G. L. Beckwith, Street Assistant. The average for the entire State was 37.4% for 1940, compared to 32.4% in 1939.

The *densest surface mixture* was placed on Contract 04TC8, IV-SC1-68-B,SJs, Route 5 to Santa Clara Street, where the average relative specific gravity was 95.6%. Raisch & Heple was the Contractor, H. S. Payson, Resident Engineer, and H. A. Hart, Street Assistant. The State average was 93.0% in 1940, compared to 93.8% in 1939.

The record for *surface smoothness* was secured on Contract 26TC1, VI-Mad-4-A, Arcola School to Madera, where the average roughness index was 8.1 inches per mile. The Contractor was Piazza-Huntley and Trewhitt-Shields, with F. W. Howard as Resident Engineer and F. B. England, Street Assistant. The average for the entire State in 1940 was 14.9 inches per mile, compared to 18.8 inches in 1939.

BITUMINOUS TREATED SURFACES

During 1940 the plant-mix type of oiled surface greatly predominated other types, about 72% of the 220 miles of plant-mix and road-mix types being plant-mix.

Spreading machines were used on several of these projects in lieu of the blade work which had been specified in the past. Under adverse conditions of weather or traffic the spreading machines offer certain very definite advantages.

Construction Records

Excellent results were obtained on several plant-mix projects as regards riding qualities. The record for surface smoothness, 5.7 inches per mile, was obtained on Contract 210TC7, X-Cal-24-B, east of Valley Springs by L. Biasotti & Son, Contractor, with A. K. Nulty, Resident Engineer. Two neighboring contracts with the same engineer had averages of 5.8 and 6.1 inches per mile. The average for the entire State for plant-mix surfacing in 1940 was 23.1 inches per mile, compared to 26.2 inches in 1939.

The record for surface smoothness for road-mix type was made on Contract 29VC3, IX-Iny-23-C, Big Pine Airport to Big Pine, where 12.9 inches per mile was obtained by Basich Bros., Contractor, with F. R. Pracht, Resident Engineer. The average for the entire State for 1940 was 49.2 inches per mile, compared to 31.9 inches in 1939. The increase in roughness is largely due to the use of materials in place containing large aggregate which is not conducive to the building of smooth surfaces.

Realignment under construction at Pajaro River Crossing of U. S. 101. Arrow points to old one-way bridge on existing road

Coast Road

A NEW FOUR-LANE LINK AND BRIDGE AT THE PAJARO RIVER

By H. S. PAYSON, Resident Engineer

THE BOUNDARY between Highway Districts IV and V is marked by the Pajaro River where U. S. 101 crosses the line between Santa Clara County and San Benito County.

The old highway bridge across this river was constructed at a period when highway standards were much inferior to those required to meet present-day traffic demands. The roadway width of the old bridge is only 18 feet 8 inches, and the design critical for present loading standards.

The budget for the 91st-92d fiscal years provided funds for replacing this structure with one of modern design and for necessary approach roads to connect with the present road on both sides thereof.

After considerable preliminary studies a location for the structure was decided upon about five hundred feet upstream from the old structure, and road approaches 2.63 miles long on new alignment provided.

The new road and bridge is of four-lane, divided highway design, beginning near the Prunedale Junction in San Benito County in District V and extending northerly to the overhead structure over the main line of the Southern Pacific Railroad north of Sargent in Santa Clara County in District IV.

STRATEGIC DEFENSE ROAD

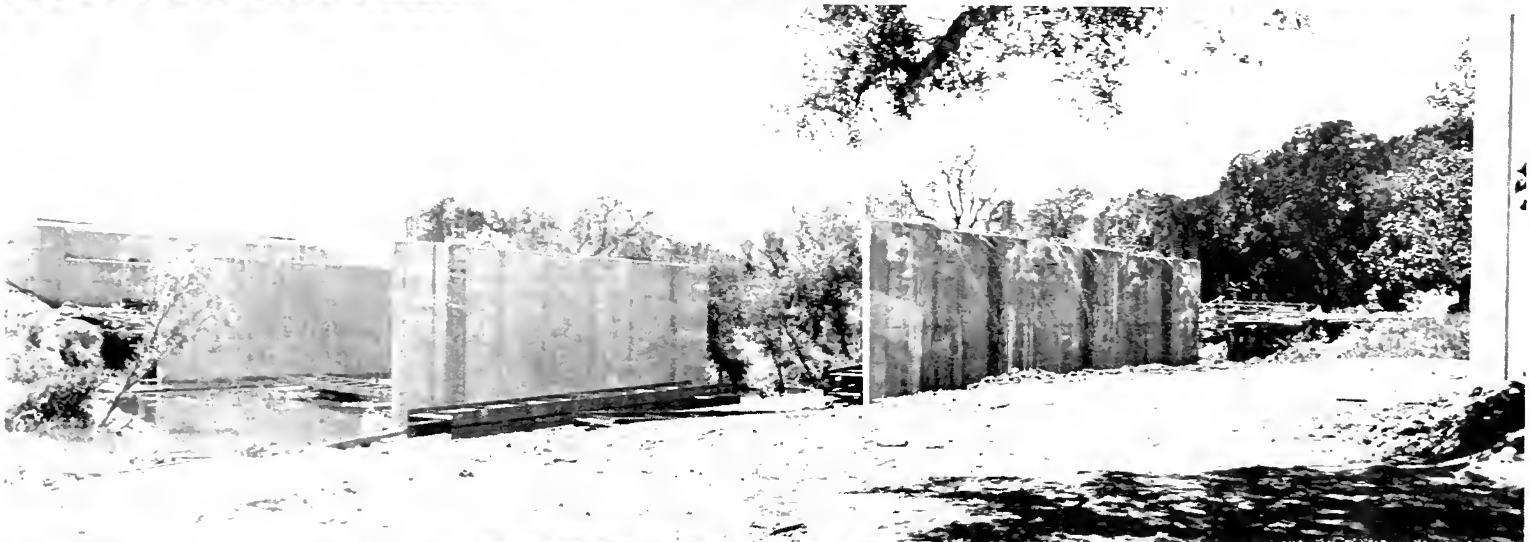
This highway is a part of State Highway Route 2, Sign Route U. S. 101, and carries a preponderant volume of traffic between San Francisco and Los Angeles, as well as being of strategic value as a part of the National Defense System.

In the design of this link of a major highway artery, provision was made for present-day safety and future traffic needs by providing long sight distances, easy grades and long radius curves. The old alignment contained 10 curves with a minimum radius of 300 feet for a total curvature of 245 degrees. This has been reduced in the new alignment to four curves having a minimum radius of 1,021 feet for a total curvature of 138 degrees.

6-FOOT DIVISION STRIP

The center division strip separating traffic lanes will be six feet wide, containing raised median bars painted white. The surface will be three-inch

(Continued on page 22)



At top—Existing narrow bridge across Pajaro River. Center—Three wide concrete piers ready for steel erection. At bottom—Large steel girder floated into position on rafts preparatory to raising with power crane

State Fair

A MODEL EXHIBIT OF DEPARTMENT OF PUBLIC WORKS IS ONE OF THE FEATURES

MOTORISTS from the four corners of the State soon will start their march on Sacramento as the California State Fair throws open the gates of the Eighty-seventh Annual Exposition on August 29th for a 10-day run through September 7th with bigger and better entertainment, exhibit and racing features promised.

In preparing the Eighty-seventh Annual Exposition, fair directors anticipate a record crowd of 800,000, to top the paid attendance of 713,625 chalked up at last year's show.

The number of fine highways which serve Sacramento from all sides make the State Capital an ideal location for the annual fair which consistently attracts larger crowds to greater and finer shows.

PUBLIC WORKS EXHIBITS

Charged with the construction, maintenance and administration of the 14,000-mile highway system is the Division of Highways which is the largest agency of the Department of Public Works under whose auspices and supervision comprehensive and realistic exhibits have been prepared showing the work of its three divisions—Highways, Water Resources and Architecture.

The exhibits will be presented in a large space on the mezzanine floor of the main building.

The highway exhibit will consist of a diorama showing developments in the construction and improvement of highways from the ox cart days to the modern freeway. Miniature figures of early period autos are seen struggling over narrow, winding dirt roads in one section. A following section shows wider, smoother surface roads with pavement widths from 15 to 20 feet, better standards of alignment and three and four lane pavements. The final scene presents a section of ultra-modern, divided superhighways with wide separation strips, grade separations, at intersecting major highways and paralleling service roads of the freeway principle of design.

Above the diorama, which is 44 feet in length, will be three mural paintings of transportation scenes of the early Spanish period, the Gold Rush days and the multi-lane restricted-access boulevards of today.

In addition to these exhibits there will be moving pictures of construction, maintenance, and operation scenes on the highways and freeways.

The Division of Water Resources plans to have an actual working model of Shasta Dam with water running over the spillway and pouring from the outlets of the powerhouse. Other models will show the various water measuring devices in operation.

The reservoir behind Shasta Dam will be shown at about average eye level with realistic scenic backgrounds and moving pictures of construction work at the dam.

The Division of Architecture exhibit will consist of photographs of many large State buildings that have been constructed and sketches of others proposed for erection in the course of the $12,000,000 program for this biennium.

OUTSTANDING ENTERTAINMENT

First presented in a small San Francisco hall in 1854, the California State Fair has grown from a modest exhibition to what is announced as the "Nation's premiere State fair, the west's foremost live stock show, and the outstanding agricultural show of the United States."

The main attraction of the entertainment features is to be a brilliant musical revue presented by celebrated stars and chorus of beautiful girls on a streamlined miracle stage before the grandstand. Outstanding singers and comedians of radio, stage and screen and nationally famous bands will provide nightly entertainment and dancing. The fair will also present this year on September 2d the Sacramento Municipal Symphony Orchestra in a concert of classical music under the direction of the conductor, Willem Van den Burg.

In the agricultural building, more than 35 counties will exhibit large areas of choice fruits, vegetables, grains, nuts, wines, minerals and ores.

In all competitive events winning contestants will share more than $182,500. Purses to be won at the horse races amount to more than $53,700 with a top purse of $5,000 for the Governor's Handicap, annual race classic, and top money of $2,000 in the State Fair Occident Stake for harness horses. Judges at the horse show will award $20,000.

The Future Farmers of America, members of the 4-H clubs and other junior farmer organizations will hold their own fair in the $500,000 group of buildings opened for them last year. The Future Farmers band will play for the annual live stock parade when the State's finest beef and dairy cattle, horses and goats pass in review before the grandstand.

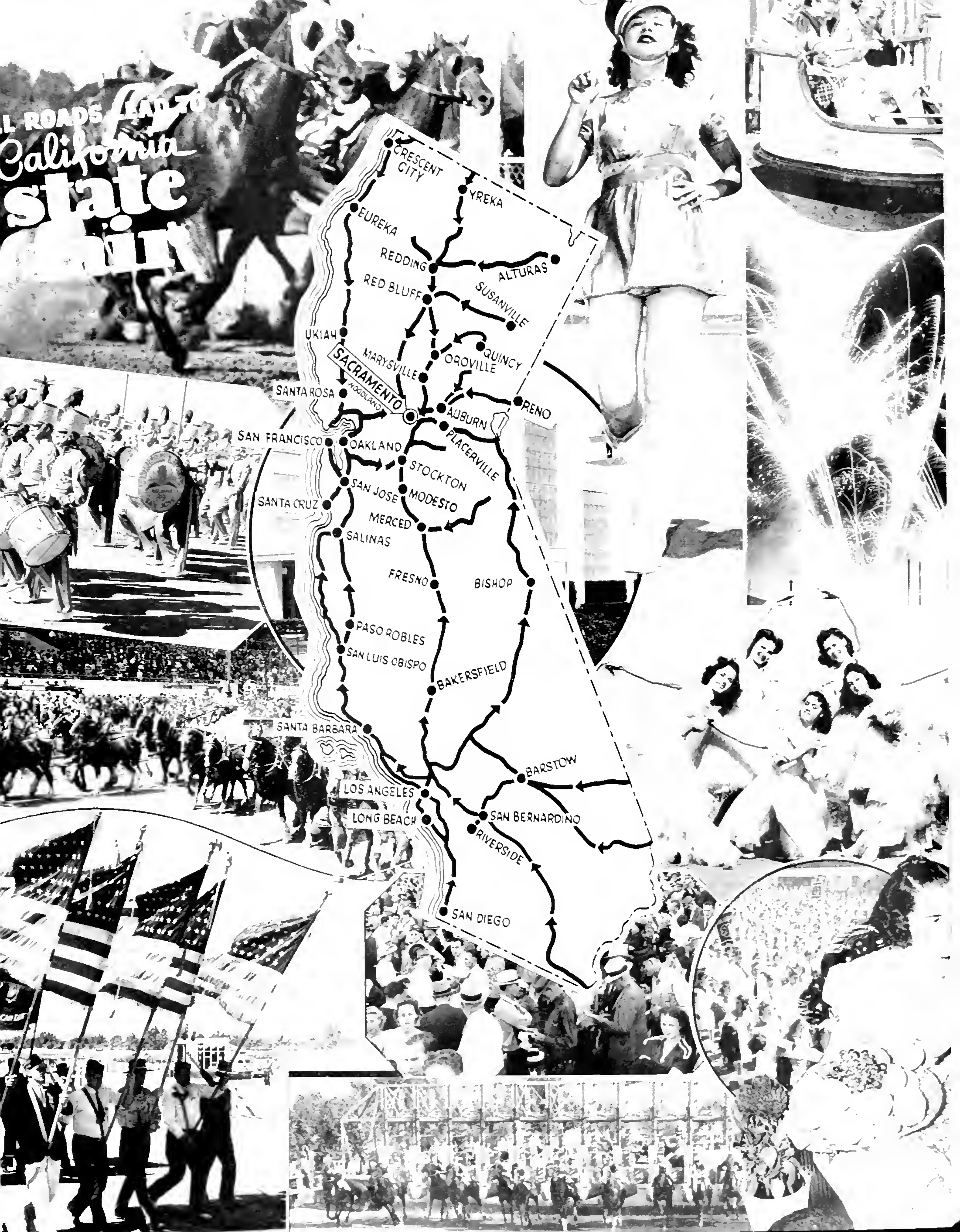
TWO NEW BUILDINGS

The 1941 Fair will see the opening of two new buildings, the Hall of Flowers and the Press Radio Building, both removed from Treasure Island and reconstructed on the fair grounds. In the green latticed Hall of Flowers, fair visitors will see a huge exposition of California-grown flowers, shrubs and ornamental plants. In the landscaped gardens surrounding the building, the Shasta Cascade Court from Treasure Island has been reconstructed with a stage, landscaping and garden.

Acquisition of the buildings by the fair organization was made possible through the cooperation of Governor Culbert L. Olson, Chairman Frank W. Clark of the California Commission for the Golden Gate International Exposition and State Director of Finance George Killion.

In the field of arts and education there will be the second annual North American Salon of Pictorial Photography with entries from all over the world, an exhibition of oil paintings and water colors by living professional California artists and more than 10,000 educational and vocational exhibits in the Education Building.

Mother—Now, Junior, be a good boy and say "Ah-h-h," so the doctor can get his finger out of your mouth.



ALL ROADS LEAD TO
California
State
Fair
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EUREKA
REDDING
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RED BLUFF
SUSANVILLE
UKIAH
QUINCY
OROVILLE
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SANTA BARBARA
BARSTOW
LOS ANGELES
SAN BERNARDINO
LONG BEACH
RIVERSIDE
SAN DIEGO

New Four-Lane Link and Bridge at Pajaro River

(Continued from page 18)

plant-mix 46 feet wide, and the shoulders will be road-mix, three inches by seven feet wide.

The project is divided into two contracts, one for the road work and one for the bridge over Pajaro River. The road work in both counties is being handled by District IV and the structure by the Bridge Department.

The principal items of road work are as follows:

194,000 cu. yds. Excavation
3,000,000 sta. yds. Overhaul
27,000 cu. yds. Imported Borrow
11,000 tons Plant-Mix Surfacing
22,000 lbs. Reinforcing Steel
200 cu. yds. Class "A" Portland Cement Concrete
174 ft. 90" Multi-plate Corrugated Metal Pipe
4,700 ft. Various Corrugated Metal Pipes.

Healey-Moore Co. & Fredrickson & Watson Construction Co. of Oakland are the contractors.

The new bridge project consists of constructing a four-span, concrete-deck, steel-girder bridge, having an overall length of 340 feet, supported on reinforced concrete piers and abutments. The spans are 52, 88, 110 and 90 feet.

The principal items of the bridge contract are as follows:

2,100 cu. yds. Excavation
337,000 lbs. Reinforcing Steel
447,000 lbs. Structural Steel
2,244 cu. yds. Portland Cement Concrete
6,570 lin. ft. Treated Douglas Fir Piles.

C. W. Coletti & Company of San Rafael are the bridge contractors.

No unusual features of construction were encountered except that both contractors were delayed by the very unusual heavy and continuous rainfall the past winter. The resultant heavy runoff washed out some of the bridge contractor's sheet piling.

The grading of the roadway was performed by D8 Caterpillar Tractors and Le Tourneau Carryalls of 14 to 20 cubic yard capacity on the short hauls and a 2½ cubic yard Northwest shovel and trucks on the longer haul.

The bridge contract is under the direction of I. T. Johnson, Resident Engineer.

The grading and surfacing contract is under the direction of H. S. Payson, Resident Engineer.

Present indications are that both contracts will be sufficiently advanced to be open to traffic late in September.

Traffic on State Toll Bridges Showed Large Increase in July

TRAFFIC on the three State-owned toll bridges continued at a high level throughout the month of July.

For the San Francisco-Oakland Bay Bridge the daily average was 53,755 vehicles, representing an increase of 9 per cent over July, 1940.

On the Carquinez Bridge the traffic was 14,612 vehicles per day, indicating a gain of 77 per cent over the same month of the previous year.

The Antioch Bridge, with a daily average of 862, showed an increase of 48 per cent over the record for July, 1940.

The vehicular traffic for July on the San Francisco-Oakland Bay Bridge and the Carquinez and Antioch bridges is tabulated below:

	San Francisco-Oakland Bay Bridge	Carquinez Bridge	Antioch Bridge
Passenger autos and auto trailers	1,503,264	413,852	22,503
Motorcycles and tricars	4,682	1,726	82
Buses	34,274	5,994	193
Trucks and truck trailers	87,071	31,165	3,836
Others	37,118	242	106
Total vehicles	1,666,409	452,979	26,720

Gas Tax Outrunning Population

Since 1930 gasoline-tax payments by the American public have shown an increase 18 times as great as the Nation's gain in population, statistics released by Federal Government agencies reveal.

During the decade ending in 1940 the country's population increased from 122,775,046 to 131,669,275, or 7.2 per cent. Gasoline taxes jumped from $494,683,000 in 1930 to $1,150,000,000 in 1940, gaining 132 per cent, or a rate of increase 18 times as great as population growth.

An all time record was established by motorists in California during the first six months of 1941 when they consumed more than 1,000,000,000 (one billion) gallons of gasoline.

Prize Bridge Presentation

A picturesque celebration to be held Saturday, September 13th, at 10 a.m. at the Orleans Bridge over the Klamath River in Humboldt County on State Sign Route 96 will mark the presentation of a bronze plaque by the American Institute of Steel Construction. The event is being held under the auspices of the Redwood Empire Association, County Supervisors, and the Eureka Chamber of Commerce.

The presentation ceremonies will include the placing of the plaque in a prominent spot on the bridge structure, announcing the fact that the bridge won the design contest for 1940 for the most beautiful steel bridge costing less than $250,000 completed in that year. The presentation address will be made by W. T. Norris, a representative of the Steel Institute and there will follow a venison barbecue luncheon, Indian ceremonial dances, and a fishing and casting contest on the Klamath River, where the steelhead will be running.

A young widow put up a costly monument to her late husband, and inscribed upon it, "My grief is so great that I can not bear it." A year or so later, however, she married again, and feeling a little awkwardness about the inscription, she solved the difficulty by adding one word to it, "alone."

Schooner Gulch Spanned by a Modern Bridge

THERE has recently been completed, on the site of one of Mendocino County coast's most historic spots on State Highway 56 a bridge of modern design which brings up to date the saga of Schooner Gulch.

To those who may be interested in early Californians and what they did, there is faintly discernible, to the west of the new structure, the old stagecoach road. Here early day stagecoaches passed over the all but forgotten wagon trail and its water level bridge bent on delivering passengers and mail to the many thriving lumber towns along the coast.

On the banks of the stream and overlooking the millpond were numerous shanties.

BUILT OWN SHIPS

Within the small harbor afforded by the stream's mouth, schooners were built to carry lumber from neighboring mills to California's budding seaports. From this modest ship building industry the name Schooner Gulch was derived.

As stagecoach gave way to power driven vehicles, and modern machinery was introduced, the low level bridge proved too frail and collapsed under the load of a steam donkey engine. A temporary bridge was then erected farther upstream until a high level redwood trestle on concrete pedestal footings could be constructed. This trestle which had been condemned as unsafe for modern traffic prior to the start of construction was replaced by the present structure.

The new bridge is of continuous reinforced concrete girder design, consisting of one 120-foot span, two 96-foot spans, and two 25-foot cantilever spans on concrete bents. A clear roadway width of 26 feet is provided. Girder depths vary from 6 feet to 11 feet 6 inches for the main span and from 5 to 11 feet 6 inches for side spans.

Of unusual interest was the design which provided that girders for the main span, south side span, and south

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Side view of Schooner Gulch bridge shows simplicity of design

Curvature of structure conforms to 800-foot radius center line

Close-up of girders in which torsion steel was used

Highway Bids and Awards for the Month of July, 1941

ALAMEDA COUNTY—Between 2.9 miles and 10.8 miles east of Mission San Jose, about 2.7 miles to be surfaced with crusher run base and armor coat. District IV, Route 108, Section A. Piazza & Huntley, San Jose, $21,670; E. A. Forde, San Anselmo, $26,946; Marshall S. Hanrahan, Redwood City, $36,866. Contract awarded to Lee J. Immel, Berkeley, $20,561.

BUTTE, YUBA, COLUSA, SUTTER, YOLO AND GLENN COUNTIES—At various locations, about 50 miles, seal coat to be applied. District III. C. F. Fredericksen & Sons, Lower Lake, $37,784. Contract awarded to Hemstreet & Bell, Marysville, $32,221.

DEL NORTE COUNTY—Remove existing bridge across Smith River about ten miles north of Crescent City. District I, Route 71, Section A. W. S. Selvage, Eureka, $7,500. E. E. Smith, El Cerrito, $7,760; Fred J. Maurer & Son, Eureka, $14,000; Kiss Crane Service, Berkeley, $7,555. Contract awarded to Frank George, Bakersfield, $3,900.

DEL NORTE COUNTY—Between one mile south and two miles north of Crescent City about 0.7 mile to be graded and surfaced with imported borrow and armor coat applied. District I, Routes 1,71; Sections B, A. Mercer, Fraser Co., Eureka, $25,532; Parish Bros., Sacramento, $28,291. Contract awarded to J. L. Conner & Sons, Calistoga, $22,482.

EL DORADO, YUBA, NEVADA AND PLACER COUNTIES—At various locations about 31 miles in length, seal coat to be applied. District III, Fredericksen & Westbrook, Sacramento, $35,056. Contract awarded to Hemstreet & Bell, Marysville, $27,349.

FRESNO-MADERA COUNTIES—Between Herndon Avenue and 1.6 miles north of San Joaquin River, about 1.1 miles to be graded and bituminous surface treatment applied. District VI, Route 125, Sections C, A. Piazza & Huntley, San Jose, $103,615; Heafey-Moore Co. & Fredrickson & Watson Construction Co., Oakland, $113,268; N. M. Ball Sons, Berkeley, $117,272, Claude C. Wood and W. C. Watson, Lodi, $123,777. Contract awarded to Fredrickson Bros., Emeryville, $99,692.

GLENN COUNTY—At Walker Creek about 1.6 miles east of Willows, a reinforced concrete bridge to be constructed and about 0.1 mile of roadbed to be graded and surfaced with plant-mixed surfacing. District III, Route 15, Section A. Contract awarded to C. C. Gildersleeve, Berkeley, $28,693.

HUMBOLDT COUNTY—At Rohnerville Curve and at Fernbridge, grading and surfacing with plant-mixed surfacing, about 0.4 mile. District I, Route 1, Sections F, G. John Burman & Sons, Eureka, $16,422; J. L. Conner & Sons, Crescent City, $17,469. Contract awarded to Mercer, Fraser Co., Eureka, $14,332.

LAKE COUNTY—Across Middle Creek and Clover Creek near Upper Lake, two reinforced concrete bridges to be constructed and about 0.27 mile of roadbed to be graded and seal coat applied. District I, Route 15, Sections A, B. Contract awarded to Louis Biasotti & Son, Stockton, $38,718.

LOS ANGELES COUNTY—At the intersection of Bishops Road and N. Figueroa Street, two reinforced concrete bridges having overall lengths of approximately 103 feet and 135 feet to be constructed. District VII, Route 165, Los Angeles. Nick Perscallo, Los Angeles, $58,864; Oberg Bros., Los Angeles, $59,176; Carlo Bongiovanni, Los Angeles, $63,333; J. S. Metzger & Son, Los Angeles, $67,451; W. J. Disteli, Los Angeles, $68,458. Contract awarded to Contracting Engineers Co., Los Angeles, $51,836.

LOS ANGELES COUNTY—Across Ramona Blvd. at Pomeroy, Cornwell and Soto Streets in the City of Los Angeles, three reinforced concrete overcrossings to be constructed. District VII, Route 26. J. E. Haddock, Ltd., Pasadena, $252,205; Ralph A. Bell, San Marino, $276,521. Contract awarded to Nick Perscallo, Los Angeles, $227,920.

LOS ANGELES COUNTY—On Figueroa Street over Amador Street and Solano Avenue in the City of Los Angeles, two bridges to be constructed. District VII, Route 165. J. S. Metzger & Son, Los Angeles, $56,927; J. E. Haddock, Ltd., Pasadena, $65,757; Carlo Bongiovanni, Hollywood, $63,656. Contract awarded to Oberg Bros., Los Angeles, $54,590.

MADERA-MERCED COUNTIES—Between 0.5 mile north of Ash Slough and Dutchman Creek, about 4.4 miles to be graded and a portion paved with portland cement concrete and a portion surfaced with plant-mixed surfacing on crusher run base. District X, Route 4, Sections C, A. Heafey-Moore Co. & Fredrickson & Watson Construction Co., Oakland, $159,272. Contract awarded to M. J. B. Construction Co. & F. Kaus, Stockton, $154,926.

PLACER COUNTY—Between Baxters and Hampshire Rocks, about 2.9 miles to be surfaced with plant-mixed surfacing. District III, Route 37, Sections D, E, F. Hemstreet & Bell, Marysville, $23,971. Contract awarded to Hayward Building Material Co., Hayward, $22,215.

PLACER COUNTY—Between Homewood and Tahoe City, about 1.6 miles to be surfaced with plant-mixed surfacing. District III, Route 38, Section A. Hayward Bldg. Material Co., Hayward, $15,040. Contract awarded to Independent Construction Co., Oakland, $9,592.

SAN LUIS OBISPO COUNTY—At Trout Creek, 1½ miles east of Santa Margarita, a reinforced concrete slab bridge to be constructed, about 0.2 mile of roadway to be graded and bituminous surface treatment applied. District V, Route 58, Section A. Trewhitt-Shields & Fisher, Fresno, $26,677; Brown, Doko & Baun, Pismo Beach, $32,635. Contract awarded to Dan Caputo, San Jose, $25,817.

SANTA BARBARA COUNTY—Between Jonata Park and Zaca, about 2.7 miles, seal coats to be applied to roadbed, gutters, dike faces and road approaches. District V, Route 2, Section D. Brown, Doko & Baun, Pismo Beach, $5,261. Contract awarded to L. A. Brisco, Arroyo Grande, $4,578.

SONOMA COUNTY—At Russian River, two miles west of Guerneville, a reinforced sidehill viaduct extension to be constructed. District IV, Route 104, Section A. C. C. Gildersleeve, Berkeley, $19,844; A. Soda & Son, Oakland, $20,480. Contract awarded to Louis Biasotti & Son, Stockton, $17,688.

Bids and Awards for June, 1941

SOLANO-YOLO COUNTIES—Between South Fork Putah Creek and one mile east of Davis and between Swingle and Yolo Causeway, about 4.6 miles to be graded and paved with portland cement concrete. District III, Route 6, Sections A,E,A. Heafey-Moore Co., Fredrickson & Watson Construction Co., Oakland, $349,390; A. Teichert & Son, Inc., Sacramento, $351,844; A. G. Raisch, San Francisco, $357,818; N. M. Ball Sons, Berkeley, $361,971. Contract awarded to Fredericksen & Westbrook, Sacramento, $347,675.

YOLO COUNTY—Between Woodland and Cache Creek about 4.5 miles in length to be graded and surfaced with plant-mixed surfacing on existing pavement and new cement treated base. District III, Route 7, Sections Wd,B. Heafey-Moore Co.-Fredrickson & Watson Construction Co., Oakland, $145,119; A. G. Raisch, San Francisco, $155,476; Piazza & Huntley, San Jose, $156,665; Hemstreet & Bell, Marysville, $161,868. Contract awarded to A. Teichert & Son, Inc., Sacramento, $142,424.

Schooner Gulch Spanned by a Modern Bridge

(Continued from page 23)

cantilever span were to be curved to conform to an 800-foot center line radius. For this innovation, torsion steel was provided in girders in addition to the usual stirrups.

The structure, one of many built or being planned for this region, has been placed on what will be the ultimate alignment for the coastal highway. Connections from the bridge to the existing highway are temporary.

The bridge and approaches were built under contract with Harold Smith, of St. Helena, at a cost of approximately $70,000.

Work has been started on a highway across the Isthmus of Panama which will connect Colon with Panama City. This new road between the Caribbean and the Pacific Ocean will be only a little over 50 miles long and will be the shortest transcontinental route in the world.

The United Commercial Travelers are advocating the painting of all school buses red, white and blue, arguing that it not only has a real patriotic appeal, but it will also provide additional safety.

First awards of the London Transport Medal for Bravery were presented recently. One was to a bus driver, who during a raid entered a burning garage and single-handed drove out numerous burning trucks amid falling bombs.

State of California

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Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

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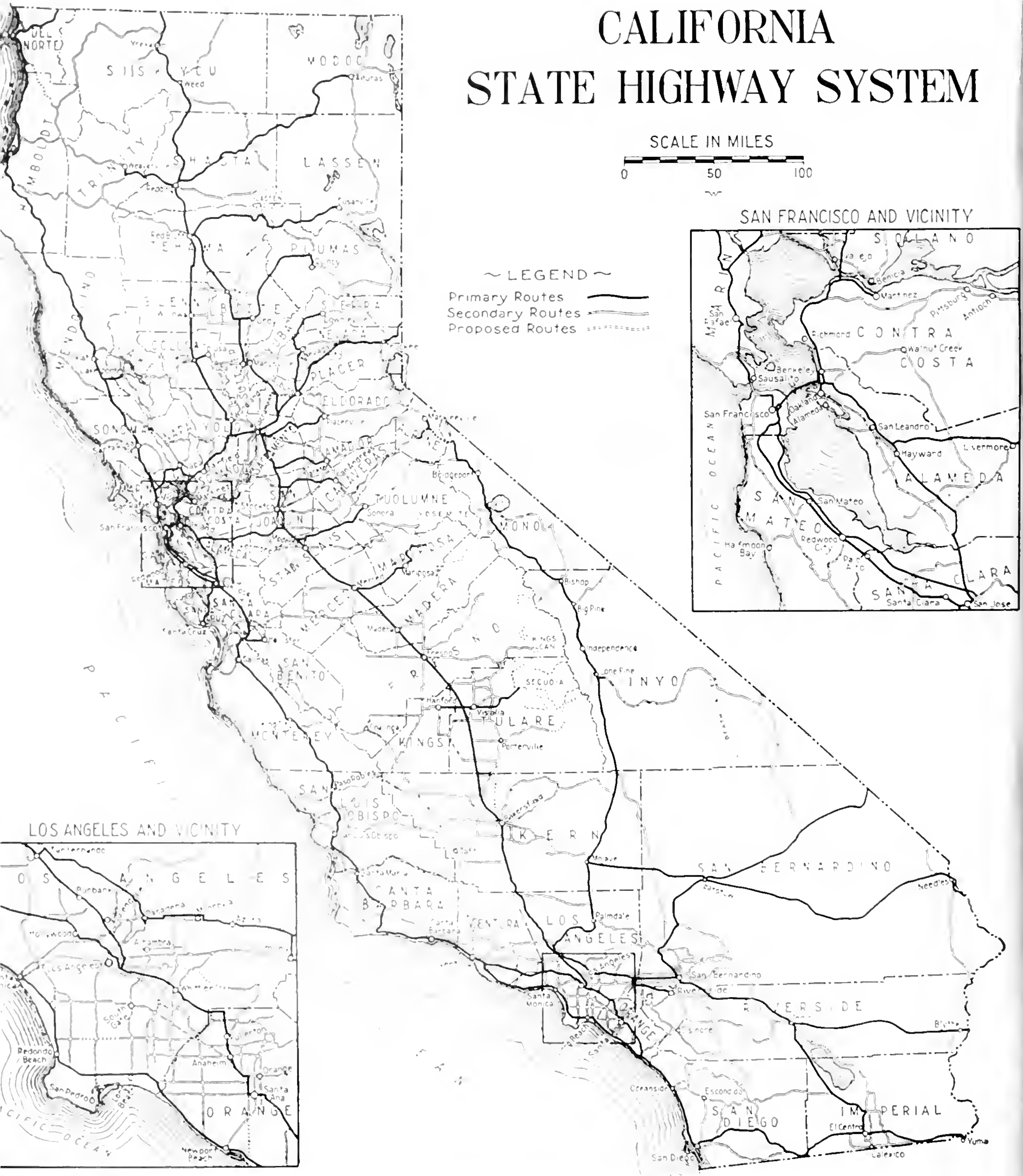

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

SECTION OF OCEAN SHORE HIGHWAY NOW UNDER PROGRESSIVE CONSTRUCTION BETWEEN SAN FRANCISCO AND SANTA CRUZ
(SEE ARTICLE IN THIS ISSUE)

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California

FRANK W. CLARK, Director C. H. PURCELL, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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Vol. 19 SEPTEMBER, 1941 No. 9

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U. S. 50 to be Kept Open All Winter

FOR the first time in its history as a transcontinental route dating from the pony express and pioneer stage coach days, U. S. Highway 50 will become an all-year highway as a result of the decision of the California Highway Commission in a meeting August 29th to provide funds for snow removal equipment and crews to keep the road open this winter over the Echo Summit and Meyer's grade bottleneck in the high Sierras of El Dorado County.

Immediately following the Commission's authorization the needed new snow plows were ordered by the Division of Highways and construction for housing crews and equipment is now under way.

U. S. 50 begins at San Francisco and extends to the Atlantic seaboard through Washington, D. C., and Annapolis. From Sacramento it gradually climbs via Folsom, Placerville and Kyburz to Echo Summit, elevation 7,394 feet and thence down Meyer's grade and along the southern and western shores of Lake Tahoe to Carson City, Nevada, and points East.

The 20 miles of highway through the high country and over the summit from Kyburz to Meyers has a total snow fall throughout the winter somewhat greater than that on Donner Summit which in severe winters exceeds 500 inches with an average snow pack of about nine feet. Because of the narrow old roadway through this section of National Forest and many hairpin turns on Meyer's grade east of the summit rendering the operation of big modern rotary snow plows impractical, the Division of Highways has heretofore only kept the road open to Kyburz and vicinity.

Two years ago the Federal Road Bureau began construction of a 2.3 mile unit of wider and safer highway on new alignment eliminating a number of the sharp turns and grades which was completed July, 1940, and work has already started on another unit to modernize the remainder of Meyer's grade to the lake valley.

At the meeting of the Highway Commission at Globin's Al Tahoe on August 29th, the matter of keeping the road open all through the winter was brought to the attention of the Commission by Director of Public Works Frank W. Clark who stated that Governor Culbert L. Olson urged that it be done for the benefit of the public of the entire State as well as for the interests of several thousand business men and residents of the southern Lake Tahoe region. He said that the Nevada Highway authorities had been keeping U. S. 50 open through the winter to the California State line and promised they would continue to do so and cooperate in every respect.

Scene on Echo Summit Highway, March 1941, before clearing

Push plow operating on Meyers grade in March, 1941, in effort to open road for automobile and truck traffic

URGED BY CIVIC BODIES

President John T. Nicholson and Committee Chairman Louis Bartlett of the Open Highway 50 Association explained the urgency of the situation from the viewpoint of the business men and residents of the Lake region and predicted the highway would develop a recreational patronage as large in winter as it is in summer. Other speakers included Senator H. E. Dillinger and Mayor Charles Molinari of Placerville; Judge Andrew Pierovich of Jackson; and representatives of the Redwood Empire Association, State Chamber of Commerce, cities of San Francisco, Oakland and Stockton and a number of other civic bodies.

Asked by Commissioner Nielsen what additional equipment and force the Division of Highways would need to keep the highway open, State Highway Engineer C. H. Purcell said two large type rotary snowplows and two four-wheel drive trucks and push plows would have to be purchased at once and quarters provided for a crew of 20 men to work day and night shifts.

Maintenance Engineer Tom Dennis explained that four buildings would be necessary including a two-story bunkhouse, like the one on the Donner Summit station; a boiler house, a truck and plow garage and a storage house for gas, oil and supplies.

Mr. Dennis also stated that there would be times during the storm periods when the road would have to be closed while the equipment was at work owing to the narrowness of about 1.6 miles of the lower Meyer's grade where it would be impossible for traffic to pass. The same condition exists at times, he said, on Donner Summit during the heaviest storms.

SPEEDY ACTION NECESSARY

State Highway Engineer Purcell told the Commission that speedy action was necessary if the road was to be kept open this winter. He said:

"Orders must be placed at once with the factories in the middle west that make the snowplows and the matter of defense priorities must be considered. It will be necessary also to secure a site from the National Forest authorities for the housing and equipment buildings and we have only about three months in which to do all this."

Mr. Purcell added that the cost of snow clearing operations would be about $40,000 annually.

UNANIMOUS VOTE

When the motion was put by Chairman Larry Barrett, Commissioners Nielsen, Vaughn, Bozzani and Hitchcock voted unanimously to keep the highway open for winter travel and authorized the Division of Highways to make the necessary expenditures for crews, housing and equipment.

Immediately following the meeting State Highway Engineer Purcell got in touch with the snowplow builders and reported to Director Clark he expected the equipment to be delivered about December 1st.

A site for the location of the bunkhouse and other buildings has been secured from the forest authorities comprising five acres near Echo Summit and a crew was immediately put to work clearing the site of trees and underbrush. Lumber, cement and other materials for the four buildings were promptly delivered and the work of building the foundations and framework is under way as this magazine goes to press.

LEGISLATURE PASSED BILL

The history of the Placerville-Lake Tahoe highway dates from 1854 when public agitation for a "post road or other road from the Sacramento Valley to the Missouri River by way of Great Salt Lake" resulted in mass meetings of citizens in San Francisco, Sacramento, Marysville, Placerville and other places and finally culminated in the Legislature passing a bill creating a commission consisting of the Governor, Secretary of State and Surveyor General to call for bids for the construction of a wagon road from the Valley of the Sacramento over the Sierra to Carson Valley at a cost not to exceed $105,000.

Governor Bigler signed the measure April 28, 1855, but through an oversight the measure failed to appropriate any money for a survey of the proposed route.

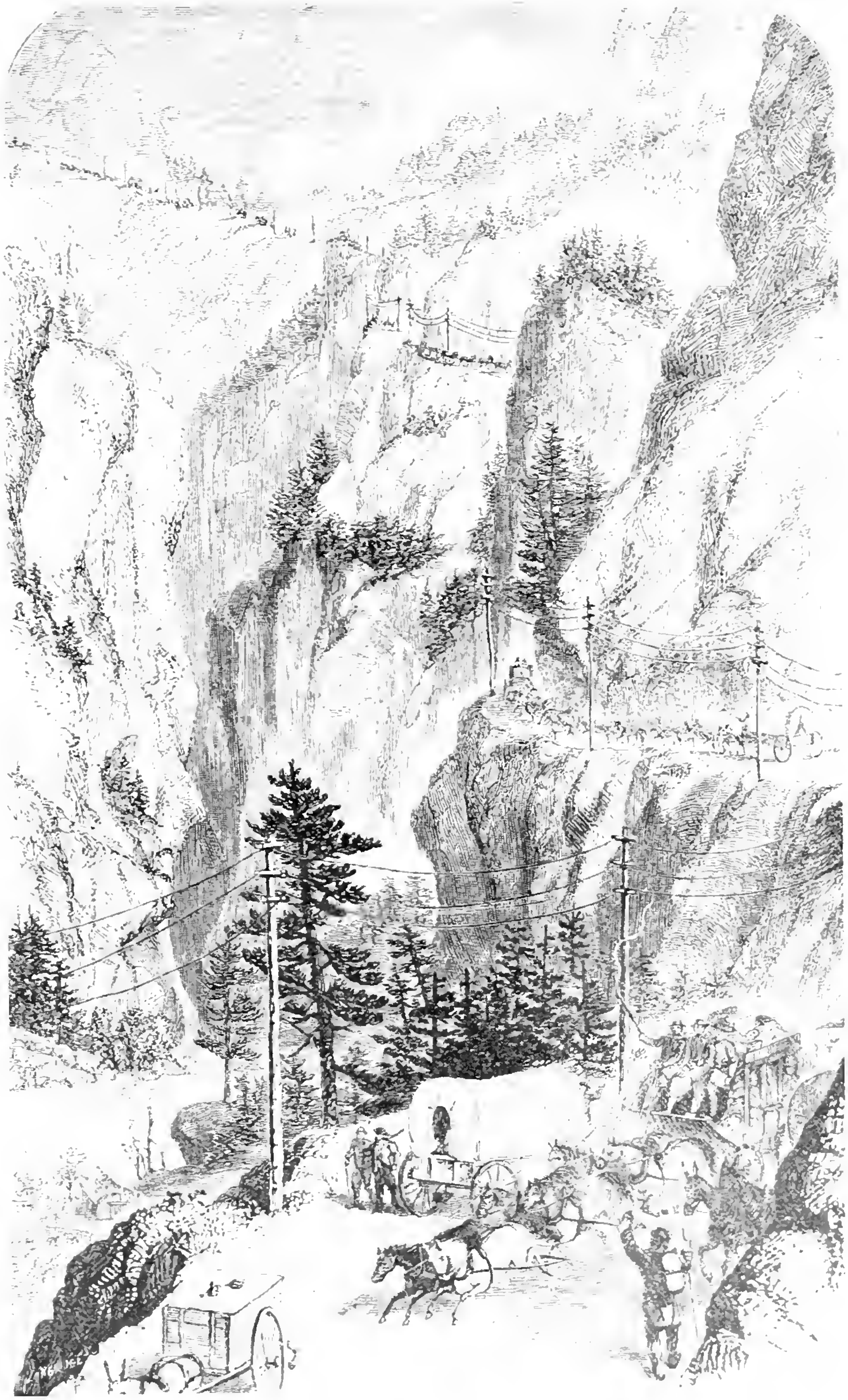
Surveyor General Marlette was obliged to advertise for public contributions to carry out the survey and commissioned State Senator Sherman Day, a well known engineer, to locate a route for the "Emigrant Road over the Sierra to Carson Valley." Day favored a route which today is the course of the State highway from Sacramento through Placerville to Lake Tahoe, then called Bigler Lake, thence into Carson Valley, Nevada.

When Day completed his survey and returned to Sacramento, Marlette set out with him to make a second survey and later directed George H. Goddard, father of Al Goddard of Sacramento to make a third investigation. Meanwhile, the State Controller refused to audit accounts under the Wagon Road Act and Marlette and those who had contributed for the surveys were out of pocket and were not repaid till April, 1857.

ROAD COMPLETED IN 1858

On May 11, 1857, representatives of Sacramento, El Dorado, and Yolo counties met and $20,000 was subscribed by Sacramento, an equal amount by El Dorado, and $10,000 by Yolo. The Day route was approved and finally in November, 1858, the road linking Sacramento and Placerville with Carson Valley was completed.

Lack of legislative support for the "Emigrant Wagon Road" as it was then called and opposition by interests involved in building the transcontinental railroad resulted in the road being taken over by private capital. Following the discovery of great silver deposits in Nevada and the resulting excessive traffic from Sacramento over the Sierra to the Comstock and other Nevada mines, the route became a toll road and paid huge dividends to its operators. Years later in 1895, when the Legislature created the State Bureau of Highways, the old pioneer toll road was taken over by the State.



Old wood cut of the Emigrant Wagon Road in 1865 from Albert D. Richardson's book, "Beyond the Mississippi," published in 1867

Shore Highway Link Abolishes 214 Curves, Opens More Fine Beaches to Public

By C. F. PRICE, Resident Engineer

A PORTION of the trail blazed by Gaspar de Portolo and his cavalcade of well over a half hundred men on his first land exploring expedition in 1769, has, after a period of 172 years, been transformed into a modern highway. A day's journey of 10 to 15 miles made by Portolo from one camp to the next can now be made in as many minutes.

A new link in the Ocean Shore Highway, State Sign Route No. 1, extending 8.8 miles from Pescadero to San Gregorio in San Mateo County, constructed over new right-of-way, has replaced 12 miles of narrow old road composed of a series of blind vertical and horizontal curves.

The old road, had a maximum grade of 8.8 per cent, 233 curves with a minimum radius of 50 feet and a total of 9219 degrees of curvature. The new highway has a maximum grade of 7 per cent, 19 curves with a minimum radius of 625 feet, and a total of 621 degrees of curvature.

This new unit in the progressive modernization of the Ocean Shore highway between San Francisco and Santa Cruz has a graded roadbed 36 feet wide surfaced with a two-lane plant mix pavement 22 feet wide and penetration oil shoulders laid on local select material and crusher run base.

It was necessary to construct two new bridges in connection with the highway project, one over Pescadero Creek and one over San Gregorio Creek. Both bridges are of continuous reinforced concrete girder design.

The Pescadero Creek Bridge consists of six 43 foot spans and two 33 foot 6 inch spans on concrete bents founded on steel piles varying in length from 25 to 50 feet below the concrete bent footings.

The San Gregorio Creek Bridge is made up of three 59 foot spans and two 44 foot spans on concrete bents also founded on steel piles varying in length from 25 to 40 feet below the concrete bent footings.

The completion of this section of highway opens to the public a new playground of sandy beaches for picnicking, bathing, and surf fishing.

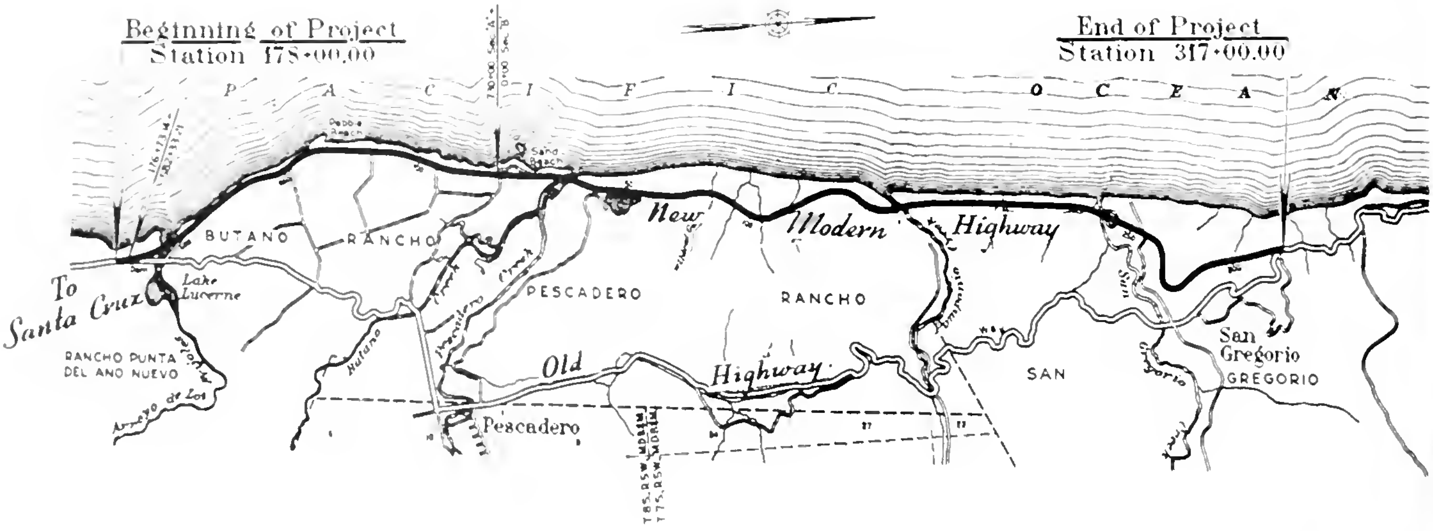
The State Administration through the Division of Highways and the County of San Mateo working in conjunction have acquired title to miles of beautiful beaches, including the far-famed San Mateo County Pebble Beach, which have been made accessible for free public recreation.

The project was set up under two contracts, one for the highway work and one for the bridges; the highway work under District IV forces, and the bridges by the Bridge Department. N. M. Ball Sons of Berkeley were the contractors on the highway section, and the Campbell Construction Company of Sacramento was the bridge contractor.

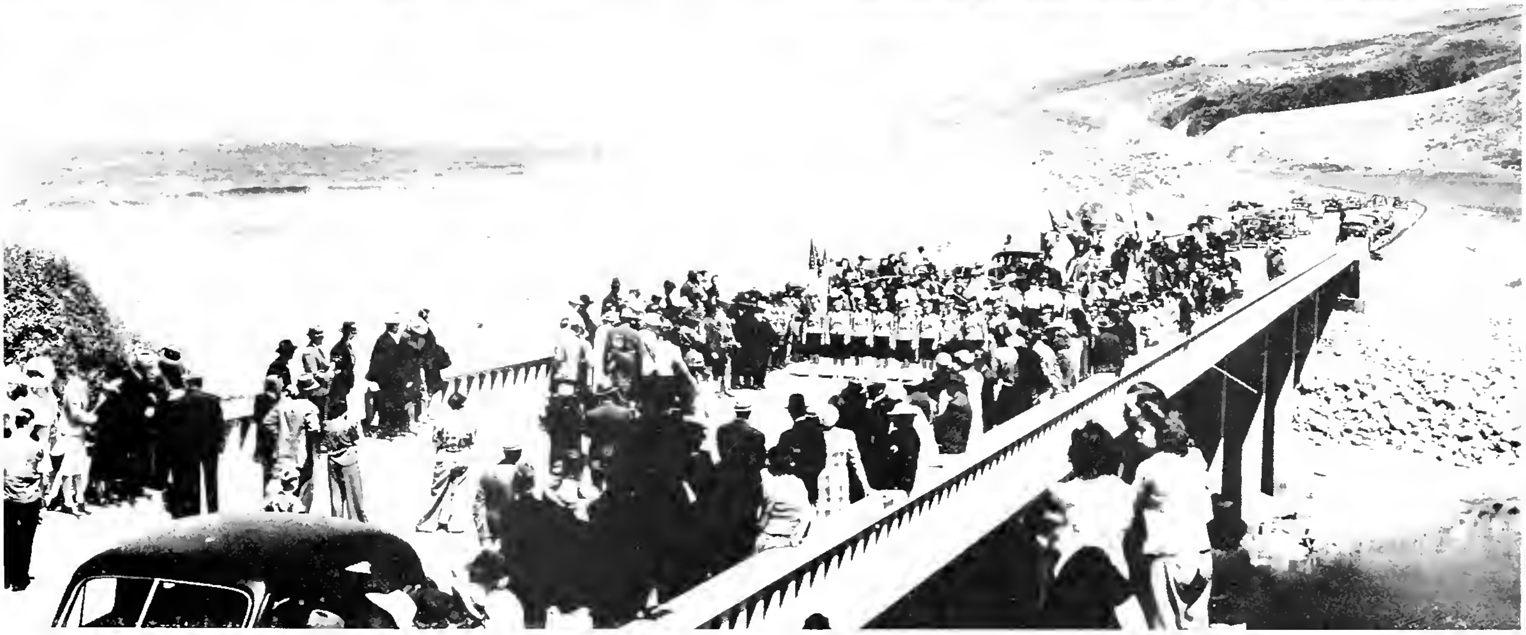
The project was financed from funds budgeted by the California Highway Commission, including Federal Aid, and by Joint Highway District No. 9, composed of the San Francisco, San Mateo and Santa Cruz counties.

Dedicatory ceremonies were held on August 17th on Pescadero Creek

(Continued on page 16)



Heavy black line shows relocated Ocean Shore Highway between San Gregorio and Pescadero opening up miles of beaches to public



Top and bottom—New Ocean Shore Highway along beaches acquired for public. Center—Dedication parade at Pescadero Creek bridge led by Native Daughters drill team

Big power shovels, tractors, bulldozers, trucks and some of 2,000 men engaged in building Arroyo Seco extension through Elysian Park

Arroyo Seco Freeway Extension Becomes a $4,000,000 Defense Highway Project

By ROBERT J. HATFIELD, Resident Engineer

CONSTRUCTION of the southerly extension of the Arroyo Seco Parkway, a certified, National Defense, WPA project sponsored by the State, is now in a spectacular stage of construction. This project, which began as a sorely needed civic improvement for the safety, convenience and economy of metropolitan Los Angeles, has now been classed as one of the roads forming a part of the National Strategic System of Roads, as designated by the War Department and entitled to priority in steel and cement materials for its completion

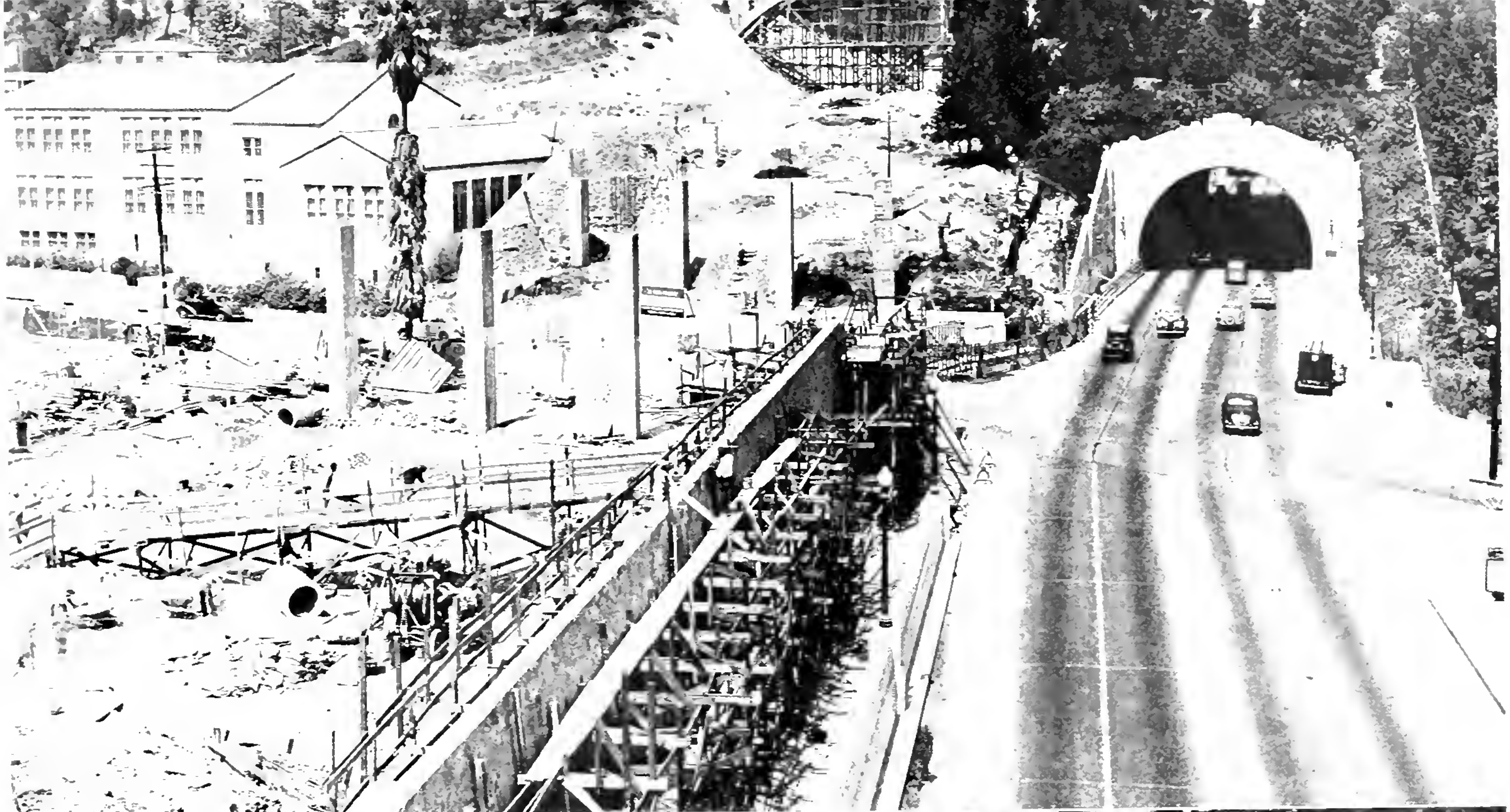
With all the concentration of effort for defense; the achievement of the ultimate safety benefits which will result is in no way curtailed or delayed.

The project was described in the April, 1941, issue of *California Highways and Public Works*, and consists of the construction of a new four-lane roadway paralleling existing Figueroa Street for a distance of approximately 1.8 miles, and extends from the present end of the Arroyo Seco Parkway southerly toward the Los Angeles Civic Center.

The improvement involves the duplication of the existing $700,000 Los Angeles River Viaduct; the removal of three-quarters of a million cubic yards of rock excavation, paving, storm drains and sanitary sewers, together with five grade separation structures, which are being performed by contract.

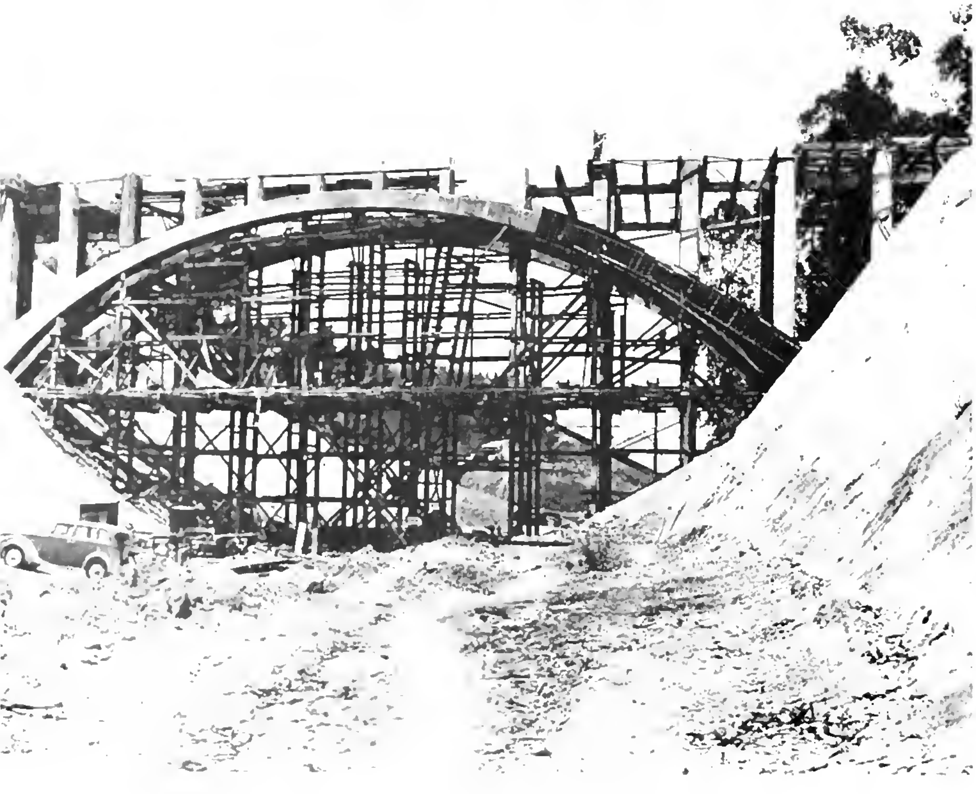
At present ten 110-horsepower tractors, equipped with 16 cubic yards capacity carryalls, bulldozers, sheepsfoot tampers or rooters, together with one $2\frac{1}{2}$ cubic yard and one $1\frac{1}{2}$ cubic yard gas shovels, a fleet of 40 dump trucks, nine air compressors, and a half dozen concrete mixers, are operating during the day and continuing operations under flood lights during the night. All available space is now occupied with equipment or squads of workmen, who total 2,000 on the job. Rock cuts, which are in the very heart of Los Angeles, are being blasted, and material removed. Storm drains are being installed; bridges are being built, and rubble walls, of greater size than ever before seen in this area, are rapidly nearing completion.

The rubble walls are particularly worthy of special comment. Thirty thousand cubic yards of broken and discarded concrete sidewalks, curbs, gutters and pavement have been and



Top view shows existing Figueroa Street tunnel on right and construction at Solano Street grade separation with Park Lane bridge in background. At bottom—Extensive grading at site of Bishops Road grade separation and construction of dam that will also serve as highway embankment. Excess excavation material is used for dam which permits extension of city-owned reservoir

Extensive grading work and site of two overhead grade separation structures at intersection of Castelar and Figueroa Streets



Close up view of Park Lane grade separation under construction

are being accumulated for the purpose of providing aggregate for the construction of retaining walls, which are not only adding to the beauty of California's first freeway, but are, as well, providing economical substitute for reinforced concrete retaining walls.

Through the cooperative efforts and planning of Los Angeles City Traffic Engineer Ralph T. Dorsey, and the city police force, the 15,000 vehicles which each day are affected by this construction, are finding their homeward and officeward paths little, if any, less convenient as every effort is made to prevent constriction of traffic in spite of the fact that a large amount of construction is constantly changing locations.

The completed project will have all of the safety features that were incorporated in the Arroyo Seco Parkway, and in addition will possess added safety features developed from experience and observation of the conduct of traffic on the Parkway.

FINE OFFICIAL COOPERATION

In the development of the safety features on this project, as well as the other details of design, we are in no small way indebted to City Engineer Lloyd Aldrich, and his deputies Merrill Butler, Hugo Winter, and Louis Arnold, who have wholeheartedly and unstintingly cooperated in all details connected with the work.

In addition to the benefits to the traveling public and the fulfilling of the important defense demands, the project provides for the enlargement of a city-owned reservoir, by the utilization of excess roadway excavation for the construction of the dam, which will also serve the purpose of a highway embankment.

In keeping with the policy established on the Arroyo Seco Parkway,

(Continued on page 24)

Traffic Count Up 10.8 per cent Over 1940; 11.2 per cent Increase In Last 7 Months

By C. H. PURCELL, State Highway Engineer

THE regular annual July traffic count taken on Sunday and Monday, July 13 and 14, shows an increase over the same counts for 1940 of 10.8 per cent. This is the largest percentage increase recorded in this annual traffic census of State highways since 1935 when travel took a decided upturn from the low years of 1933 and 1934.

The heavy percentage increase shown is even more impressive when it is noted that this brings the total cumulative increase over the same period of 1934 to more than 70 per cent.

It is also to be noted that, while these annual counts are direct comparisons between July periods, our regularly occupied monthly count key stations indicate that for the full seven months (January to July inclusive) of the present year the increase has been even somewhat higher than that recorded in the annual census, being approximately 11.2 per cent.

Increases were shown by all the main groupings of routes, the smallest being in that group made up of routes ordinarily considered as "recreational."

As was to be expected, rather spectacular increases appear on certain routes in those areas largely influenced by heavy defense activities. Among these are Routes 14, 19, 22, 74, 78, and that portion of Route 56 in San Luis Obispo and Monterey Counties. While these instances are noteworthy because of the abnormal growth in traffic over the previous year, the general picture also shows a decided increase throughout the entire State highway system.

No change was made from the regular procedure of previous years in the manner of taking the count. Actual recording covers the 16-hour period from 6 a.m. to 10 p.m. for both Sunday and Monday. Traffic was segregated by hourly periods into the following vehicle classifications: California passenger cars, out-of-state passenger cars, buses, light trucks, heavy trucks, trailers drawn by trucks, trailer coaches, and other passenger-car trailers.

These comparisons for the various route groups are as follows:

PER CENT GAIN OR LOSS FOR 1941 COUNT AS COMPARED WITH 1940

	Sunday	Monday
All Routes	—12.14	—10.47
Main North and South Routes	—11.87	— 9.53
Interstate Connections	—15.44	—11.91
Laterals Between Inland and Coast	—15.87	—14.48
Recreational Routes	— 5.76	— 6.84

The gain or loss of traffic volume for State Highway Routes 1 to 80 inclusive, which constitute the basis for the foregoing summary, is shown in the following tabulation:

		1941 Per cent gain or loss			
		Sunday		Monday	
Route	Termini	Gain	Loss	Gain	Loss
1	Sausalito-Oregon Line	1.07		3.63	
2.	Mexico Line-San Francisco	13.84		11.34	
3.	Sacramento-Oregon Line	6.31		2.71	
4.	Los Angeles-Sacramento	11.37		7.86	
5.	Santa Cruz-Jc. Rt. 65 near Mokelumne Hill	9.05		2.94	
6.	Napa-Sacramento via Winters	4.82		7.54	
7.	Crockett-Red Bluff	26.33		26.02	
8.	Ignacio-Cordelia via Napa	16.10		16.91	
9.	Rt. 2 near Montalvo-San Bernardino	14.03		10.25	
10.	Rt. 2 at San Lucas-Sequoia National Park	6.51		2.61	
11.	Rt. 75 near Antioch-Nevada Line via Placerville	12.79		18.08	
12.	San Diego-El Centro	28.65		31.40	
13.	Rt. 4 at Salida-Rt. 23 at Sonora Jc.	1.32		4.98	
14.	Albany-Martinez	44.00		49.08	
15.	Rt. 1 near Calpella-Rt. 37 near Cisco	1.47			6.20
16.	Hopland-Lakeport		16.40		19.53
17.	Rt. 3 at Roseville-Rt. 15, Nevada City	2.82			5.86
18.	Rt. 4 at Merced-Rt. 40 near Yosemite	4.02			7.84
19.	Rt. 2 at Fullerton-Rt. 26 at Beaumont	35.04		30.43	
20.	Rt. 1 near Arcata-Rt. 83 at Park Boundary		5.04		10.50
21.	Rt. 3 near Richvale-Rt. 29 near Chilcoot via Quincy		0.78	15.98	
22.	Rt. 56. Castroville-Rt. 29 via Hollister	36.00		40.55	
23.	Rt. 4 at Tunnel Sta.-Rt. 11, Alpine Jc.	6.55		5.09	
24.	Rt. 4 near Lodi-Nevada State Line		4.45	7.89	
25.	Rt. 37 at Colfax-Rt. 83 near Sattley		20.53		12.99
26.	Los Angeles-Mexico via San Bernardino	14.30		5.27	
27.	El Centro-Yuma	21.99		10.20	
28.	Redding-Nevada Line via Alturas		1.30	0.71	
29.	Peanut-Nevada Line near Purdy's	7.54		9.95	
31.	Colton-Nevada State Line	19.98		26.56	
32.	Rt. 56. Watsonville-Rt. 4 near Califa	13.12		11.96	
33.	Rt. 56 near Cambria-Rt. 4 near Famosa	37.93		23.00	
34.	Rt. 4 at Galt-Rt. 23 at Pickett's Jc.		5.23		7.05
35.	Rt. 1 at Alton-Rt. 20 at Douglas City	4.87		29.18	
37.	Auburn-Truckee	3.45			6.07
38.	Rt. 11 at Mays-Nevada Line via Truckee River	4.19			5.34
39.	Rt. 38 at Tahoe City-Nevada State Line		3.80		3.14
40.	Rt. 13 near Montezuma-Rt. 76 at Benton	15.09			5.32
41.	Rt. 5 near Tracy-Kings River Canyon via Fresno	22.04		10.00	
42.	Redwood Park-Los Gatos	3.76			7.75
43.	Rt. 60 at Newport Beach-Rt. 31 near Victorville	1.90		2.00	
44.	Boulder Creek-Redwood Park		2 06		1.36
45.	Rt. 7. Willows-Rt. 3 near Biggs	12.08		27.99	
46.	Rt. 1 near Klamath-Rt. 3 near Cray		15.75	4 26	
47.	Rt. 7. Orland-Rt. 29 near Morgan	1.74			1.49
48.	Rt. 1 N. of Cloverdale-Rt. 56 near Albion	3.82		13.48	
49.	Napa-Rt. 15 near Sweet Hollow Summit	16.19		1.58	
50.	Sacramento-Rt. 15 near Wilbur Springs	17.83		20.08	
51.	Rt. 8 at Schellville-Sebastopol	14.41		2.08	
52.	Alto-Tiburon	8.93		23.43	
53.	Rt. 7 at Fairfield-Rt. 4 at Lodi via Rio Vista	21.91		15.13	
54.	Rt. 11 at Perkins-Rt. 65 at Central House	13.60		19.37	
55.	Rt. 5 near Glenwood-San Francisco	4 12		12.77	
56.	Rt. 2 at Las Cruces-Rt. 1 near Fernbridge	21.09		17.35	
57.	Rt. 2 near Santa Maria-Rt. 23 near Freeman via Bakersfield	9.96		10.42	
58.	Rt. 2 near Santa Margarita-Arizona Line near Topock via Mohave and Barstow	23.31		16.00	
59.	Rt. 4 at Gorman-Rt. 43 at Lake Arrowhead		1.70	3.65	
60.	Rt. 2 at Serra-Rt. 2 at El Rio	0.88		7.37	
61.	Rt. 4 S. of Glendale-Rt. 59 near Phelan	21.07		13.92	
62.	Rt. 171 at Northam-Rt. 61 near Crystal Lake	4.31		4.05	
63.	Big Pine-Nevada State Line		23.27		46.92
64.	Rt. 2 at San Juan Capistrano-Blythe	11.35		9.32	
65.	Rt. 18 near Mariposa-Auburn		10.79		0.64
66.	Rt. 5 near Mossdale-Rt. 13 near Oakdale		3.23		1.60
67.	Pajaro River-Rt. 2 near San Benito River Bridge		6.24		8 17
68.	San Jose-San Francisco	6.92		6.57	
69.	Rt. 5 at Warm Springs-Rt. 1. San Rafael	18.83		21.83	
70.	Ukiah-Talmage	52.41		29.14	
71.	Crescent City-Oregon Line		5.55		6 30
72.	Weed-Oregon Line	45.19		65.30	
73.	Rt. 29 near Johnstonville-Oregon Line	21.81		7.37	
74.	Napa Wye-Cordelia via Vallejo and Benicia	55.20		78.52	
75.	Oakland-Jc. Rt. 65 at Altaville	21.73		7.09	
76.	Rt. 125 at Shaw Ave.-Nevada State Line near Benton		12.99	2.36	
77.	San Diego-Los Angeles via Pomona	31.50		21.24	
78.	Rt. 12 near Descanso-Rt. 19 near March Field	46.99		37.04	
79.	Rt. 2, Ventura-Rt. 4 at Castaic	2 38			5.69
80.	Rt. 51. Rincon Creek-Rt. 2 near Zaca		0.24		9.11

Governor Olson Dedicates and Opens California Institution for Men at Chino

By ANSON BOYD, State Architect

LOOKING the wire mesh gates to the 2600 acres of the highly publicized, harassed, and investigated "Prison without walls" at Chino, California, the new California Institution for Men has accepted its quarters from the Department of Public Works, turned its back upon the stormy history of its construction era, and entered upon the most scientific penal program of rehabilitation in the country.

Six years ago this project was launched with a $400,000 appropriation to purchase land for a prison for "the rehabilitation" of "first offenders." Six hundred seventy-one thousand dollars was spent for land. The history of this project is written in a 122 page report of the Joint Legislative Fact-Finding Committee, which traced the steps leading to the financial collapse of the program, the cancelling of the contract for private architectural services at the request of Governor Olson by Legislative action, the ousting of the old Prison Board by action of the chief executive, and the rearrangement of the remaining balances, totaling approximately 9 per cent of the original project budget, which were left to return this institution to its originally conceived purpose.

10 STRUCTURES PROGRAMMED

On March 31, 1939, a Legislative act became effective cancelling the contract between a Los Angeles firm of architects employed by the old Prison Board and placing the project under the jurisdiction of the Department of Public Works with orders to erect the works as drawn.

The entire project was rearranged financially to fit the depleted funds remaining after the PWA declined consideration of an $806,000 grant application and $1,007,000 had been spent with no major buildings yet built.

The major buildings shown in the accompanying photographs are those finally constructed out of a total original project calling for more than 40 structures, programmed to house 1140 men. As received by the Department of Public Works, there was space for 236 men. By salvage methods this capacity was increased by the Division of Architecture to 440 men.

The plans for these buildings were originally drawn by the architects employed by the old Prison Board and were completed with certain internal rearrangements by the Division of Architecture to conform to the policy of the newly appointed Prison Board which has determined that this Institution shall be developed and operated in accordance with the original Legislative statute calling for a "rehabilitation" Institution.

The entire institution lies about two miles south of the town of Chino in Los Angeles County, Southern California, and is in the center of one of the two 1300 acre blocks making up its lands. The block occupied by the buildings is surrounded by a cyclone type chain link fence with barbed wire guard along its upper member. There are mushroom type guard posts surrounding the entire plot, which under the present policy of operation are not in use.

The Administration Building faces the main entrance road and looks south toward a range of low hills below Chino, over the acreage which is to be used for farming. This Administration Building is a 3-story, reinforced concrete structure, built in large part by the Works Progress Administration together with civil service employees of the State, and a number of individual contracts.

Its first floor houses the warden's office and clerical staff to the left of the entrance; the visitors' section, supervisors' dining room and commissary to the right. On the east half of the second floor are clerical offices and board rooms. The remainder of the second and third floors provide housing for unmarried supervisors.

The Administration Building is huge and monumental in design, is air-conditioned throughout, as are the other structures, and contains the most elaborate equipment for the handling of prisoners in a maximum security institution.

SECURITY FEATURES UNUSED

Across the rear of the Administration Building, facing what is now the recreation yard, is a 20 foot reinforced concrete wall surmounted by guards' walks and bullet proof gun towers. The remainder of this maximum security wall, estimated at $140,000, was not erected.

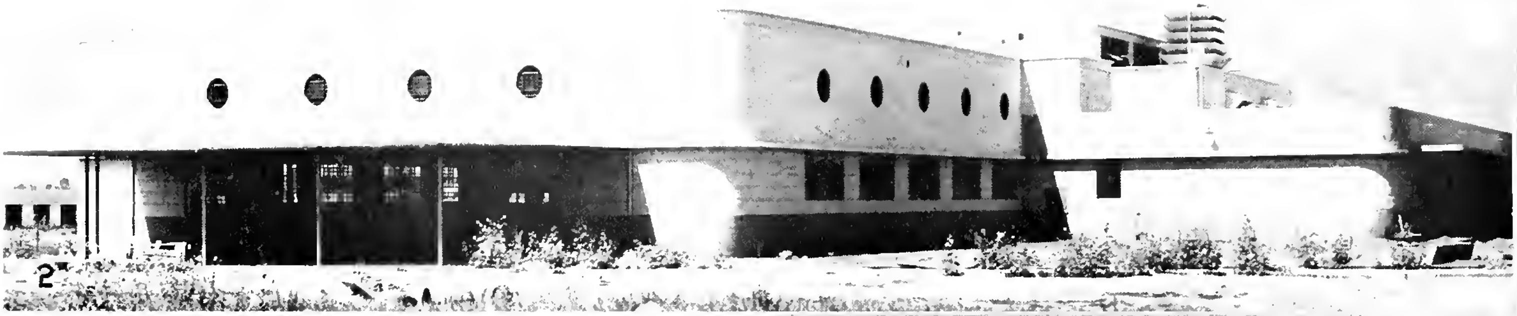
These "security" features are not in use. The interior of this building has been rearranged by the Division of Architecture, reducing materially the luxurious quarters proposed for the Prison Board and including vitally needed facilities which had been omitted by the shrinkage of the funds.

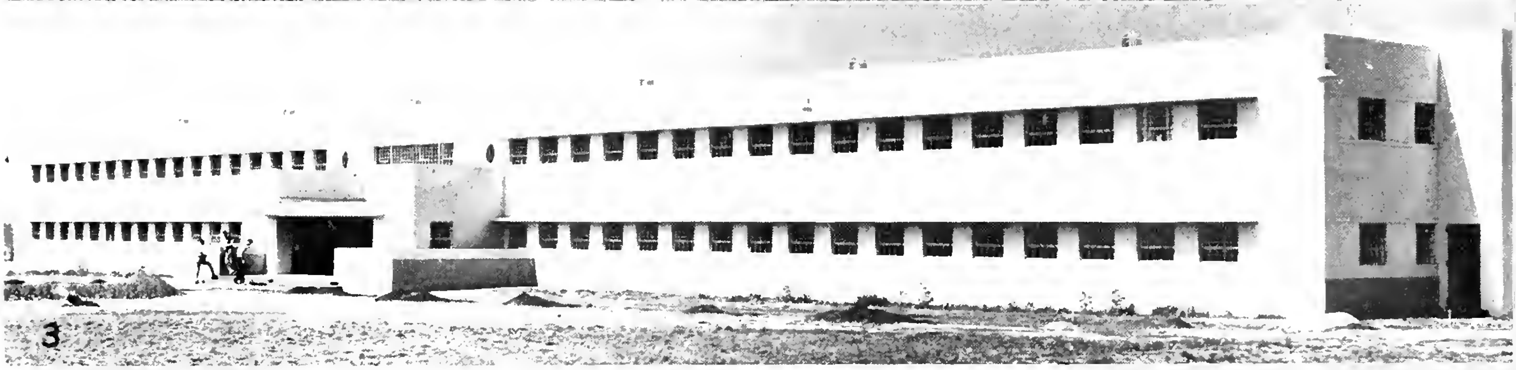
Immediately to the northwest of the Administration Building is the Observation Cell Unit, a reinforced maximum security disciplinary structure. In it are the much publicized cell doors which were, however, manufactured by the Consolidated Steel Company of Los Angeles. This building and the other major units, excepting the Administration Building, were built under general contracts.

INTERIOR REARRANGED

With the accession of the new Prison Board to office, it was possible for the Department of Public Works to rearrange the interior of this building, installing a second floor for open dormitory housing of inmates thereby considerably increasing the capacity of the institution and reducing the disciplinary cells accordingly, it being contemplated that disciplin-

(Continued on page 16)

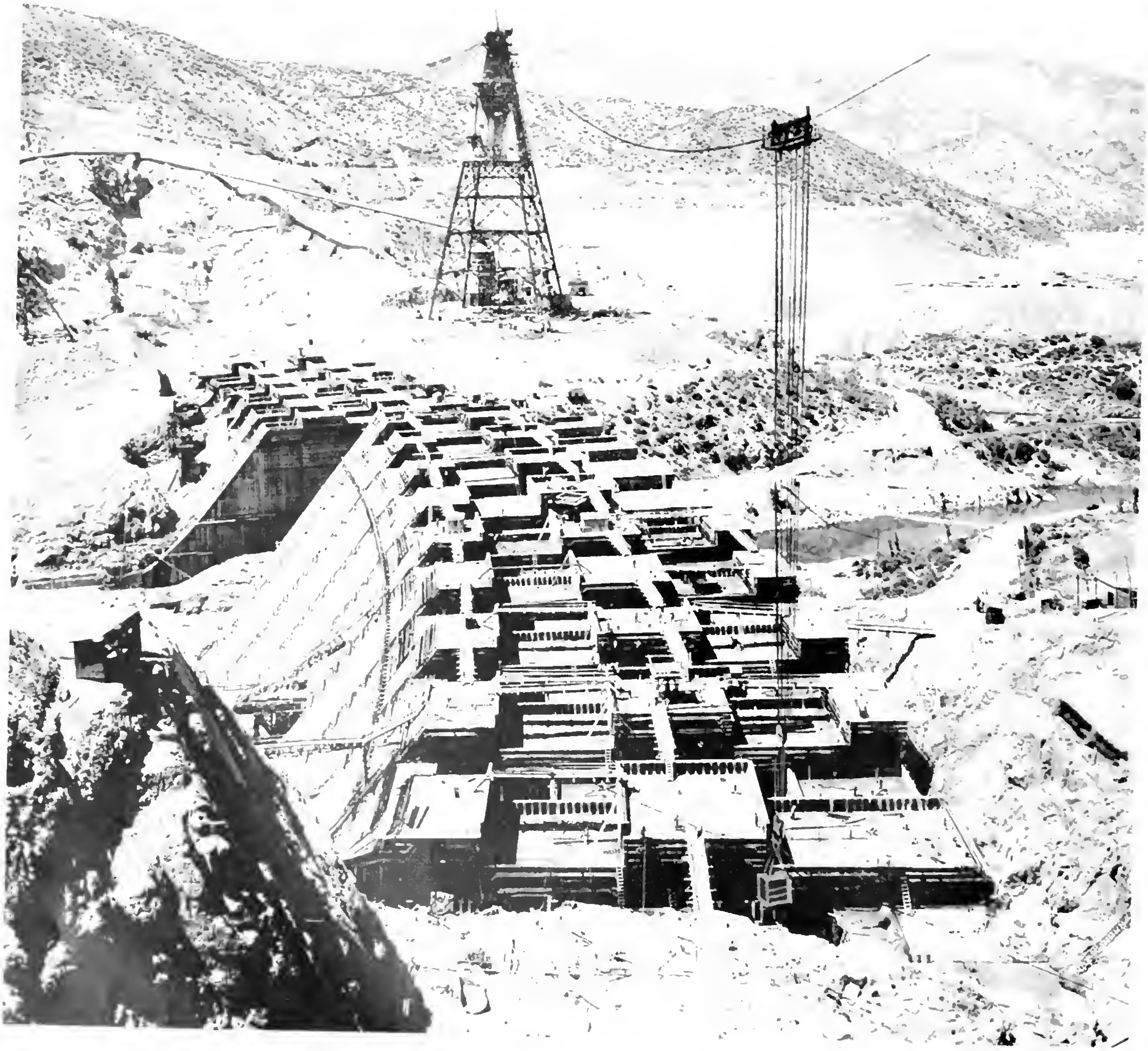




Chino institution buildings. No. 1—Observation cell block, a two-story building with 52 single rooms on first floor and 4 dormitories on second floor housing 44 beds each. 2—Mess hall, a reinforced concrete structure seating 1,200 inmates. Also contains kitchens and storerooms. 3—Westerly dormitory, a 2-story structure housing 136 men in single rooms and recreation rooms on each floor. 4—Barber shop, laundry and bath house containing shower rooms, dressing rooms and 12 barber chairs

Construction Methods Vary at Two

A GIANT cable system, consisting of a head tower where control works are located and seven tail towers, is being used to span the Sacramento River Canyon for pouring of concrete at Shasta Dam. Concrete buckets suspended from the cables carry 8 cubic yards per trip. On September 1st, Shasta Dam was 57 per cent complete with approximately 1,770,000 yards of concrete placed since the first bucket was poured in July 1940.



This view of Shasta Dam shows the progress of concrete pouring made to date by the cable system

reat Dams of Central Valley Project

AT Friant Dam, a trestle system is being used to pour concrete. Instead of concrete buckets being swung across the canyon from cables, small diesel-electric cars carry the concrete buckets out on a trestle, from which they are picked up by huge cranes and lowered onto the forms. Bucket capacity is 4 cubic yards. On September 1st, Friant Dam was 83 per cent complete with approximately 1,626,000 yards of concrete placed.

This view of Friant Dam shows the progress of concrete pouring made to date by the trestle and crane system

Ground cover plantings have proved unsatisfactory protection when planted on sterile slopes

A sandy highly erodable slope left in good condition to retain top soil protective cover

Importance of Flatter Cut Slopes in Stabilization by Vegetative Processes

By H. DANA BOWERS, Landscape Engineer

THE practicability of stabilizing slopes by natural vegetative processes is slowly but steadily becoming recognized as a desirable item of highway construction.

Naturally there exist differences of opinion among engineers as to just how necessary this item actually is, particularly regarding the merits of stabilization by natural rather than artificial means.

Regardless of opinion the fact remains that too little attention has been given to that phase of highway construction pertaining to the erosion of cut slopes, and that lack of attention has, and still is, by excessive repair costs, reducing the amount of funds available for highway construction.

Many dollars are uselessly expended annually on miles of highway loading and hauling eroded material from the base of cut slopes. Many such slopes are existant solely because of design calling for a steep slope ratio regardless of the height of the cut. It is these low cut slopes, hardly noticeable in passing and seemingly unworthy of any consideration, infinitesimal in themselves, that boost the cost of maintenance to surprising figures, considering the highway system as a whole.

Nature performs miracles in self-preservation if given an even break

Erosion control by artificial means such as oiling is always subject to failure and demands constant repair

Finished 1½:1 slope too smooth to retain lumpy adobe top soil. Header-board above plant mix ditch line to hold cover soil

Lumps or granular particles can not be expected to stick to a 1½:1 smooth surface. Roughening is necessary

Gravel slope on which erosion was prevented by top soil cover damaged by pedestrians climbing up and down

and with a little encouragement can be made to work to our advantage without charge.

However, the result of the fast-acting force of gravity, accentuated by steep slopes, is more than the slow processes of revegetation can cope with. Therefore, in order to take advantage of this "free labor," we must furnish a reasonable opportunity for the natural establishment of protective growth.

The flattening of slopes alone is not sufficient to reduce erosion particularly in friable or highly erodable soils. Increased slope exposure results in increased erosion unless humus is present. Once erosion gulleys are formed, very little opportunity remains for natural vegetation to gain a foothold since all naturally disseminated seeds fall in these gulleys and are washed away by the first rains.

By blanketing slopes with topsoil, the humus so essential to erosion control is supplied. Soil which contains no humus is of no value from an erosion standpoint other than to create a bed wherein seeds will more quickly sprout. In this case humus and usually fertilizer must be added.

Like all activities dealing with the natural elements, no definite rule can be laid down which will apply to all conditions alike. Practically every project will have a variance in soil type that may or may not call for some change in erosion control procedure.

The general sequence of operations in blanketing sterile slopes with topsoil is as follows:

1. In designing the project slopes must be made as flat as possible. The steepest slope upon which topsoil can be economically held is 1½:1. However, ease of application and effectiveness of control increase directly as the slope is flattened.

2. Determine area of slope surface and compute quantity of topsoil required to provide a cover of 6 inches minimum thickness.

3. Remove the topsoil layer containing humus from within the excavation limits and stockpile or windrow this soil outside of the slope stakes.

4. Excavate the cut in such manner as to leave a fairly rough surface. Irregularities up to 6 inches from a plane surface are acceptable. Scraper excavation will leave horizontal grooves and ridges which act as terraces to hold the topsoil. Smooth bladed surfaces, especially on a 1½:1 slope will not hold dry or lumpy topsoil, without water or support.

5. Immediately following excavation of each particular slope the topsoil blanket should be applied. Delaying this operation allows loose subsoil to filter down the slope and fill the

(Continued on page 24)

Cut slopes, 1½:1 that were blanketed with 6 inches of top soil as part of contract

Cut slopes with transition at the ends of cuts and protected with top soil present a natural appearance

Administration Building, a 3-story reinforced concrete structure housing Warden's office, clerical staff, visitors' section and Board rooms

Governor Olson Opens Chino Institution For Men

(Continued from page 10)

ary cases will be transferred to other State prisons.

North of the Observation Cell Unit is the Westerly Dormitory, a medium security cell block housing 136 men, a reinforced concrete, 2-story structure. The entrance, in accordance with the original plans under which the building was erected, is controlled by a guards' booth with customary gun ports. On the first and second floors are dayrooms for recreation and each wing of the building contains single room cells closed with steel cell doors.

Beyond the dormitory building are the laundry and the kitchen and mess hall buildings. The laundry provides shower facilities for the inmates as well as laundry equipment sufficient for an institution of the size proposed for this group, and in the mess hall and kitchen unit, as illustrated in the photograph, seating is available for 1200 inmates in the present mess hall and the kitchen is capable of serving this number as well as an additional mess hall of equal size. A restudy of the entire feeding system in the offices of the Division of Architecture, has permanently eliminated the necessity for this second mess hall and its consequent capital outlay.

Inasmuch as no storage or warehouse facilities capable of housing more than a week's supply of staples was included in the plans at the time this project came into the jurisdiction of the Department of Public Works, a new warehouse is now being built from savings in the original funds to accomplish this purpose. The warehouse is immediately north of the kitchen.

On the grounds, to the northeast of the mess hall building, is a powerhouse and electric substation of sufficient capacity to care for this institution for a number of years to come.

At the extreme northeast corner of the 1300 acre plot is a water distribution system with elevated tank and storage reservoirs, and in the southeast corner is an adequate sewage disposal plant erected by the Works Progress Administration under State sponsorship.

Under construction at the present time and not illustrated, is an institutional hospital adequate for the needs of this group of buildings for several years. It is being built at approximately 60 per cent of the cost originally proposed and out of savings due to the rearrangement of funds available.

The institution was dedicated by Governor Olson and occupied for the uses for which it was intended within the original time schedule and within the funds originally appropriated.

It is probable that the continued development of this "rehabilitation" institution will approach its ultimate growth within the funds appropriated for the current biennium.

Shore Highway Link Abolishes 214 Curves

(Continued from page 4)

Bridge, State, County, and Joint Highway District officials took part in the ceremonies at which Deputy Director of Public Works Morgan Keaton represented Governor Olson and Director Frank W. Clark. A short program of speech making preceded a barbecue served in Pescadero under the auspices of the Pescadero Junior Chamber of Commerce.

Progress in construction of the Ocean Shore Highway has advanced steadily under the cooperative efforts of the State and the Joint Highway District.

The highway has been constructed to modern standards between a connection with Junipero Serra Boulevard at the south city limits of San Francisco to Moss Beach via Thornton, where it crosses the Skyline Boulevard, Edgemar and Rockaway Beach.

Improvement in Santa Cruz County has been accomplished through two contracts between one and one-half miles south of Davenport and Waddell Creek.

The most spectacular project was the elimination of the notorious Pedro Mountain grade by the construction of the six-mile section between Farallone City and Rockaway Beach.

Views of rock and concrete jetty at Jenner that is keeping open Russian River channel to ocean

Jenner Jetty Defies Ocean's Storms

FOR the first time since the old steel trestle and rock retaining wall at the mouth of the Russian River were battered to pieces by Pacific storms nearly 10 years ago, the mouth of the river has been kept open throughout the past winter and summer.

This has been brought about by construction of Jenner Jetty, a concrete-capped rock structure extending 600 feet out into the sea from the mouth of the Russian River.

The jetty stands as a tribute to the skill of engineers in the Division of Water Resources, State Department of Public Works, who planned and supervised the construction and to the cooperation of sportsmen and adjacent counties whose money provided the funds.

The State Fish and Game Commission appropriated $55,000 from its game license fees. Sonoma County contributed $5,500, Mendocino County $550 and sportsmen's organizations provided approximately $4,500 worth of materials.

The major portion of the jetty was installed last fall and withstood the battering of one of the heaviest winters the Pacific has had in years. Last Spring work was resumed and the jetty was completed late in June.

CHANNEL KEPT OPEN

Meanwhile sportsmen and others interested in the recreational possibilities of the Russian River have watched with interest to see whether the bar which has closed the mouth of the river twice each year would reform. A channel was opened through the bar in October last year and has not since closed. The channel is gradually shifting to the point engineers anticipated due to construction of the jetty.

The rock structure of the jetty was built with three grades of heavy rock quarried especially for the purpose. Class A rock, amounting to 3,560 tons, was in pieces ranging from 5 to 16 tons each, with at least 50% over 7 tons. Class B rock, amounting to 5,638 tons, was in pieces ranging from 1 to 5 tons each, with over 50% weighing more than 3 tons. Class C rock, amounting to 1,060 tons of quarry run weighing up to 1 ton, with 30% not less than 1 ton.

SOLID CONCRETE CAP

These huge rocks were bound together with infiltrated concrete and a solid concrete cap and side walls, with a minimum thickness of two feet. The structure is 12 feet wide at the top and 25 feet wide at the bottom.

The construction contract, awarded to the Basalt Rock Company of Napa, was for $47,000. Engineering sur-

(Continued on page 24)

Highway Relocation Near Jamestown Cuts Through Vein of the Mother Lode

By C. J. TEMBY, District Office Engineer

THE recently completed 1.04 miles of State highway between Jamestown and a point one mile southerly was officially opened and dedicated on August 31, 1941, by the Jamestown Boosters Club, in conjunction with the Tuolumne County Highway Committee of the State Chamber of Commerce.

This new improvement crosses the Mother Lode south of Jamestown, commonly referred to as "Jimtown," in the vicinity where gold was first discovered in Tuolumne County, at which point the Chambers of Commerce of Jamestown and Sonora have erected a monument dedicated to the pioneers and commemorating the event.

The north end of the improvement connects with the main street of Jamestown, a picturesque mining town, typical of those to be found in the Mother Lode country. To this day, some of the original buildings will be found there. On the west side of the new right of way and immediately adjacent thereto, stands an old wooden house constructed of timber brought around Cape Horn.

The Harvard Mine is located near the south end of the new work. In latter years this mine has been reopened for development and exploration purposes. Other mines in this general vicinity have been reopened.

The highway improvement replaces a portion of the old road of inferior design that included several curves having radii varying from 110 to 1,900 feet and grades that were short and rolling with very restricted sight distances.

The old road was on narrow traveled way, which together with the poor alignment and grades was inadequate for the volume and speed of traffic now using this portion of the State highway. Traffic counts indicate approximately 3,000 vehicles using this portion of the highway daily, of which more than 15 per cent are trucks.

The average speed of traffic as recorded by official count is 46 miles per hour, with 85 per cent of the traffic indicating a speed of 52 miles per hour. The accident record for 1940 indicates 1.3 accidents per mile, and 1.7 accidents per million vehicle miles.

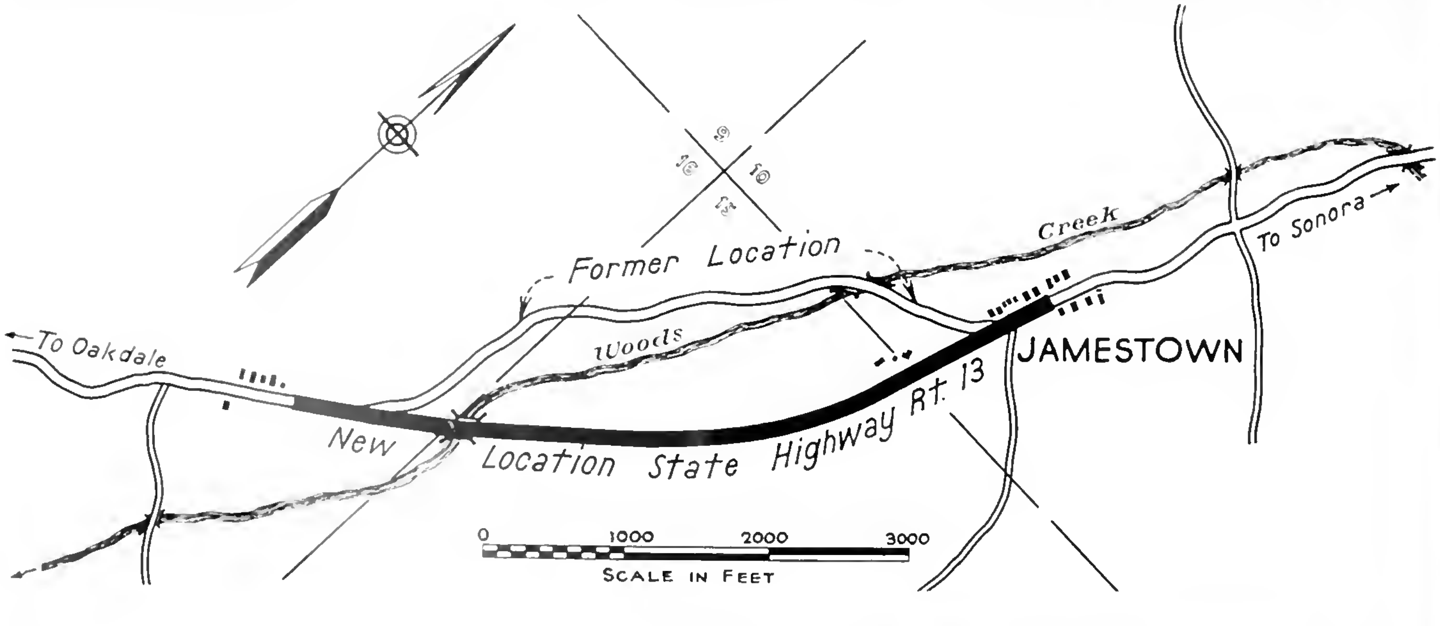
The new work provided for the construction of a 26-foot roadbed with 22-foot traveled way, consisting of 0.21-foot road-mixed surfacing on 0.33-foot thickness of gravel base on about one foot of imported borrow.

The alignment on the improved project consists of three long tangents separated by two curves of 3,000 and 5,000 feet radii, respectively. The grades are long, rolling grades, with a maximum gradient of 6.7 per cent separated by long vertical curves.

The following table presents the comparative alignment data.

	Existing	New
Number of curves existing	13	2
Maximum radius	1,900 feet	5,000 feet
Minimum radius	110 feet	3,000 feet
Total curvature	307 degrees 12 min.	37 degrees 03 min.
Net length	5,850 feet	5,515 feet

The old road crossed Woods Creek with a concrete bridge on a skewed angle crossing. The bridge was 21 feet wide and 60 feet long. The angle of the bridge crossing with sharp curves at each end was very hazardous to traffic using this portion



of the road. There has been constructed on the realigned route a new three-span, reinforced-concrete-girder bridge, 130 feet in length, consisting of a center span 50 feet long and two approach spans on each side of the center span, each 40 feet long.

The work involved approximately 36,000 cubic yards of roadway excavation; 6,000 tons of imported borrow; 4,000 tons of gravel base; 2,500 tons of mineral aggregate (surfacing); 17,000 square yards of mixing and compacting surfacing.

Construction was completed by the firm of Dan Caputo from San Jose, at a cost of approximately $55,000.

Top—Section of realigned highway into Jamestown. Center—Mother Lode vein exposed by highway cut. Bottom—Gold discovery monument near highway

New Divided Highway Cut-off Between La Mesa and El Cajon in San Diego

By EARL E. SORENSON, District Construction Engineer

SAN DIEGO, located in the southwestern corner of the United States, is bounded on the west by the Pacific Ocean, and on the south by Baja California, Mexico. Access over domestic highways is therefore confined to the north and east, and gateways in these two directions become increasingly important.

The northern entrance, U. S. 101, improved several years ago, to what was then considered adequate standards, has been made obsolete by the rapid increase of 50 per cent in population in the last year, and its reconstruction is now being planned.

The easterly approach over U. S. Highway 80, while not so heavily traveled as U. S. 101, is nevertheless carrying such a rapidly increasing load that the elimination of bottlenecks is imperative.

CROSSES THE CONTINENT

Known as the "Broadway of America," this route starts at the most southwesterly point in the United States on the Pacific, the Old Spanish Lighthouse on Point Loma, and extends across California, spans the Colorado River at Yuma, crosses Arizona, New Mexico, Texas, and on through the eastern states to the Atlantic. It is the most southerly modern highway paralleling the Mexican Border, and as such, assumes strategic military importance.

In addition to handling an ever-increasing flow of tourist traffic from the east to San Diego, it also taps the fertile Imperial Valley, with a potential area of productive soil in excess of one million acres. Intensive farming of even larger areas in this valley awaits only the construction of additional canals to make the full use of Colorado River water available.

Across the 100 miles separating San Diego from this "Garden Spot," there is trucked annually an enormous tonnage of dairy products, grain, alfalfa, perishable vegetables and fruits, and building materials.

The two most serious bottlenecks over this distance were the old Mountain Springs Grade, now being reconstructed, and the highway through La Mesa, which is now superseded by the new La Mesa Cut-off, completed a short time ago.

Formerly traffic was compelled to travel through La Mesa over residential and business streets, on sharply rolling grades, and on to El Cajon over a narrow road confined on one side by the San Diego and Arizona Eastern Railway, and on the other by Mt. Helix. This section, already overcrowded by local traffic, constituted not only a hazard, but a serious delay to fast, through traffic.

The improvement starts at West La Mesa and extends to the City of El Cajon, a distance of approximately four miles. This new highway bypasses La Mesa to the north, and intercepts the old alignment at Grossmont, from whence it has been reconstructed and widened the balance of the distance to El Cajon.

4-LANE DIVIDED HIGHWAY

Four lanes were constructed, separated either by curbs or by a variation in grade, the latter method being employed at locations where the old road could be salvaged, but where a higher standard of gradient was advisable on the new portions.

The major portion of the excavation was through, what geologists inform us was once, the bed of the Colorado River. Ages ago, before the formation of the coastal range, extending through this section, the Colorado River crossing San Diego emptied into the Pacific, leaving huge deposits of stones varying in size from marbles to boulders, which were worn round and smooth as they were rolled and abraded by the action of flood waters which had transported them for hundreds of miles. Comparison of their composition with material occurring near the source of the Colorado and its tributaries verifies this theory.

Later, geological distortions raised the coast range and the old river bed, forcing the Colorado to empty into the Gulf of California, and left the low rolling hills of river bed material, through which the major portion of the road now passes.

The La Mesa cut-off improvement was made under three separate contracts, at a total cost of approximately \$567,000 including rights of way. The contracts for grading and paving were carried out by the Griffith Company of Los Angeles and the V. R. Dennis Construction Company of San Diego.

Oberg Brothers of Los Angeles constructed an overhead crossing at the San Diego and Arizona Eastern Railway tracks in La Mesa.

Approximate major quantities involved consisted of:

Roadway Excavation	455,000 cubic yards
Overhaul	4,000,000 station yards
Imported Borrow	22,000 cubic yards
P. C. C. Pavement	10,000 cubic yards
A. C. Pavement	21,000 tons

The work involved the application of practically all features of modern design, such as grade separations between railroad and highway traffic; opposing traffic separations by reflectorized curbs; rolled curbs; and by profile separations. Three separate intersection channelizations were made and sodium vapor lighting systems installed. The paving included both asphaltic concrete and portland cement concrete. Slope protection was obtained by planting of native grasses, and beautification by planting of Cocos Plumosa Palms, and Mesembryanthemum.

Motor transport and allied industries supply one-seventh of all railroad freight. Railroad use of motor trucks is rapidly expanding.

The four-lane divided highway cut-off recently completed in San Diego County between La Mesa and El Cajon includes practically all features of modern design such as grade separations, opposing traffic separations by reflectorized curbs, profile separations and channelization islands

Realignment Eliminates Bottleneck On Sign Route 41 in Cottonwood Pass

By R. S. BADGER, District Construction Engineer

A REALIGNED section of State Sign Route 41 through the Cottonwood Pass in Kern County was opened to travel on September 2, 1941, eliminating a narrow, old road that constituted a traffic bottleneck.

The section just completed extends from the San Luis Obispo-Kern County line easterly through rolling hill pastures to the westerly edge of Sun Flower Valley. Easterly from that point the route crosses this valley and a low range of hills into the Kettleman Plains, crosses the westerly edge of the famed Kettleman Hills oil fields, thence to Kettleman City, Fresno and Yosemite Park.

As the traveler follows the tops of ridges across "the hills" he can see Tulare Lake, fed by the waters of the Kings, Kaweah, Tule, and, in some instances, by water diverted from the Kern River.

Several years ago a section of highway had been improved to modern standards, westerly from the Kern County-San Luis Obispo County line to a junction with U. S. Route 466, just east of Cholame. The usefulness of the improvement in San Luis Obispo County had been impaired because of the section of narrow, crooked, winding road in Kern County. Many had considered "the longer way around" via Keck's Corner and Devil's Den to be "the shortest way across."

Now the bottleneck has been removed by the construction of a wide two-lane highway surfaced with a bituminous-mix surfacing and placed on pleasing grades and alignment.

To the appreciation of the improvement, expressed by the average traveler, is added that of the Army men now quartered in the cantonments on the coast roads, but whose families or *interests* are in the San Joaquin Valley. The Army camps have naturally caused a large increase in the use of this direct route between the valley and Paso Robles on the Coast Highway, and without doubt it will be a distinct asset to the Nation as a defense road.

On this modernized highway one glides smoothly through oak-studded, gracefully rolling hills. It is quite easy to allow the imagination to picture the Spanish Don, a-horse, surveying his rancho and cattle grazing on the hills and plains. The cattle are still there, thousands of them.

Section of new, wide two-lane highway with bituminous mix surfacing recently completed on Cholame lateral through Cottonwood Pass

View of realigned State Sign Route 41 that connects Yosemite Park and San Joaquin Valley with the coast at Cambria

No particular difficulties were encountered during construction except that for a considerable period heavy rains plus a deep clay soil, effectively stopped construction while the rains continued.

Due to the remoteness of this section it was not economically feasible, at this time, to import commercial rock for surfacing. Also there was an unusual absence of suitable select subgrade material. Therefore, the top 12 inches of the road bed was surfaced with a crushed sandstone obtained from a ledge near the middle of the contract, and which, although soft, tested with a high bearing value and provided an excellent support for the traffic.

The top two inches of this material was crushed to a slightly finer grading, and after the base was primed with SC-2, it was road-mixed with SC-3, using a road pug and motor graders. The sandstone found at this location was admitted for use as base and surfacing, as it was the only rock available without unduly high expenditures.

If found necessary in the future, it could be protected by a thin wearing surface of imported hard rock so that in any event there will be no financial loss. The project covered 4.79 miles and cost approximately $125,410. R. Windele was Resident Engineer; Griffith Company, Los Angeles, the contractors, with John Gregg as superintendent.

August Traffic Breaks All Records On State-owned Toll Bridges

TRAFFIC on the State-owned toll bridges continued at an unusually high volume throughout the month of August, breaking all previous records on the San Francisco-Oakland Bay Bridge as well as on the Carquinez and Antioch bridges.

On the San Francisco-Oakland Bay Bridge the daily average was 58,365 vehicles, indicating an increase of about 8 per cent over the record for August, 1940. The heaviest single day's traffic occurred on August 24 when 69,024 vehicles crossed the bridge. This record has been exceeded on only six other days since the opening of the bridge.

The average daily traffic on the Carquinez Bridge was 15,748 vehicles which exceeds the record of the same month of the previous year by about 70%. The heaviest single day's traffic was 23,203 vehicles occurring on August 31.

At the Antioch Bridge the daily average of 944 vehicles showed an increase of 63% over the traffic of August, 1940.

The vehicular traffic for August on the San Francisco-Oakland Bay Bridge and the Carquinez and Antioch bridges is tabulated below:

	San Francisco-Oakland Bay Bridge	Carquinez Bridge	Antioch Bridge
Passenger autos and auto trailers	1,632,348	443,480	23,852
Motorcycles and tricars	5,242	1,290	66
Buses	44,673	6,053	187
Trucks and truck trailers	88,640	37,108	5,090
Others	38,426	272	60
Total vehicles	1,809,329	488,203	29,255

Federal park officials predict an all-time record of travel in National parks this season. A recent check showed that visitors to National parks this year have increased 17 per cent over 1940.

Meanwhile, travel records of the dam show an increase of 22,899 over figures for July of last year, and a total increase of 128,501 persons over the corresponding period in the travel year 1940.

Bids and Awards for the Month of August, 1941

INYO COUNTY—Between Cottonwood Creek and 3.3 miles north, about 3.4 miles to be graded and surfaced with plant-mixed surfacing. District IX, Route 23, Sections J.K. Oswald Bros., Los Angeles, $66,733; A. S. Vinnell Co., Alhambra, $66,741. Contract awarded to Basich Bros., Torrance, $61,740.

KERN AND INYO COUNTIES—Between Freeman and Haiwee, 14.1 miles, applying seal coat on portions. District IX, Route 23, Sections E.H. A. S. Vinnell Co., Alhambra, $13,423. Contract awarded to Basich Bros., Torrance, $11,341.

LASSEN COUNTY—At Fredonyer Summit, about 0.2 mile slide area to be established. District II, Route 29, Section B. Scheumann & Johnson, Eureka, $34,784. Contract awarded to Poulos & McEwen, Sacramento, $32,085.

SANTA CLARA COUNTY—Between 2.1 and 5.5 miles east of Gilroy, about 2.6 miles to be surfaced with gravel base and armor coat. District IV, Route 32, Section A. Contract awarded to Piazza and Huntley, San Jose, $18,412.

SOLANO AND NAPA COUNTIES—Between 0.6 mile and 2.3 miles north of Route 208, about 1.7 miles to be graded and surfaced with Portland cement concrete and asphalt concrete. District X, Route 7, Sections G.A. Contract awarded to Heafey-Moore Co. & Fredrickson & Watson Construction Co., Oakland, $128,157.

SONOMA COUNTY—Between Sheephouse Creek and Duncan Mills, about 2.7 miles to be surfaced with gravel base and armor coat. District IV, Route 104, Section A. Helwig Construction Co., Sebastopol, $15,614; E. A. Forde, San Anselmo, $18,637. Contract awarded to Sheldon Oil Co., Suisun, $13,745.

YUBA AND BUTTE COUNTIES—Between Linda Corners and "D" Street Bridge and between 1.9 miles north of Yuba County line and Union School, about 8.4 miles to be surfaced with plant-mixed surfacing. District III, Routes 3, 87, Sections B,A. Hemstreet & Bell, Marysville, $13,924. Contract awarded to Union Paving Co., San Francisco, $12,725.

YUBA COUNTY—Between Marysville and Hallwood, about 2.3 miles to be surfaced with crusher run base and seal coat applied. District III, Route 15, Section A. Contract awarded to Hemstreet and Bell, Marysville, $16,772.

Jenner Jetty Defies Ocean's Storms

(Continued from page 17)

veys, supervision and inspection costs amounted to $5,782. The remainder of the $65,550 fund provided for construction was used in building timber pile crest wall extending a distance of 1,200 feet landward from the rock and concrete section, and other preparatory work.

State engineers who designed the jetty and supervised its construction included State Engineer Edward Hyatt, the late Deputy State Engineer R. L. Jones, and G. H. Jones, Supervising Hydraulic Engineer. The detailed plans were prepared by Van G. Horton and Max Bookman.

In charge of construction supervision for the State during the contract period were W. G. Schulz, P. E. Stephenson, F. M. Huson and C. O. Schellenger.

Ex Commissioner and Editor Sends His Compliments

◆

VISALIA TIMES-DELTA
Visalia, California

Editor
California Highways and Public Works
Department of Public Works
P. O. Box 1499
Sacramento, California

Dear Mr. Howe:

As a former member of the California Highway Commission I want to compliment you on the excellent publication which is now being put out by the Department of Public Works under your direction. I look it over and read some of the articles in each issue with interest, for although State highway work is on a very much larger scale than it was in my day, I have never gotten over my interest in better highways in California. * * *

Naturally the Central Valley Water Project is very close to the hearts of the people down this way. I was present at the organization meeting of the first association created in California to raise money to exploit the Marshall plan, which was the forerunner of the Central Valley Water Project.

I assure you if there is anything we can do to assist your organization in any way with publicity of importance to highway and water development in this section of the State you will find us ever ready to cooperate.

Fraternally yours,
CHAS. A. WHITMORE,
Editor.

$4,000,000 Defense Highway Project

(Continued from page 8)

Elysian Park is being developed, recreational areas are being created, and Los Angeles' most beautiful park will be made more accessible and usable to all of its citizens. This splendid public achievement has been made possible by the very fine spirit of cooperation, which has been enjoyed for the past years, between the State Engineers, the Highway Commission, Director of Public Works Frank W. Clark and city officials of Los Angeles, especially with the Board of Park Commissioners, of which Mrs. Fred Watson is president, and with the Works Progress Administration represented by Mr. Russell Amory, Administrator, and his Chief Deputy, Mr. Ray Spencer.

The cost of the project is divided between State Gasoline Tax Funds, money supplied by the Works Progress Administration and the City of Los Angeles. The total cost will be greater than originally contemplated, due to rising prices of materials, equipment and labor. The probable total will be in the neighborhood of $4,000,000.

Of this amount, $1,800,000 will be provided by the State, $1,900,000 by WPA, and $175,000 by the City of Los Angeles, as cosponsor. The estimate includes cost of right of way, parks and engineering.

Importance of Flatter Cut Slopes

(Continued from page 15)

irregularities which are so valuable in their retention of the topsoil. Pulverizing and moistening the topsoil aids materially in placing and retaining it on the slope.

6. If seeding is considered necessary it should be done immediately upon completion of the topsoil blanket before rain or heavy dew can form a crust upon which the seed cannot be retained.

If it is impossible to obtain sufficient topsoil in this manner, imported topsoil must be used. If topsoil is not available humus material in the form of straw or manure may be worked into the slope surface.

State of California

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CALIFORNIA STATE HIGHWAY SYSTEM

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

DOUBLE DECK PIT RIVER BRIDGE, TO CARRY HIGHWAY AND RAILROAD OVER SHASTA DAM RESERVOIR LAKE, NEARING COMPLETION

(SEE ARTICLE IN THIS ISSUE)

OCTOBER
1941

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California

FRANK W. CLARK, Director   C. H. PURCELL, State Highway Engineer   J. W. HOWE, Editor   K. C. ADAMS, Associate Editor

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Vol. 19   OCTOBER, 1941   No. 10

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Grading Completed on Relocation of U. S. 99 Shasta Dam Reservoir Unit of Central Valley Project

By M. FREDERICKSEN, Resident Engineer

THE grading of the relocated Pacific Highway (U. S. 99) through a portion of the reservoir to be formed by the Shasta Dam unit of the Central Valley Project in Shasta County, has been completed. This work has been in progress since October, 1938, and will be entirely ready for public use during the summer of 1942.

A section 3.5 miles in length is in use at present, but the remaining southerly 12-mile section is yet to be paved, and the completion of the Pit River Bridge accomplished before it can be turned over to traffic.

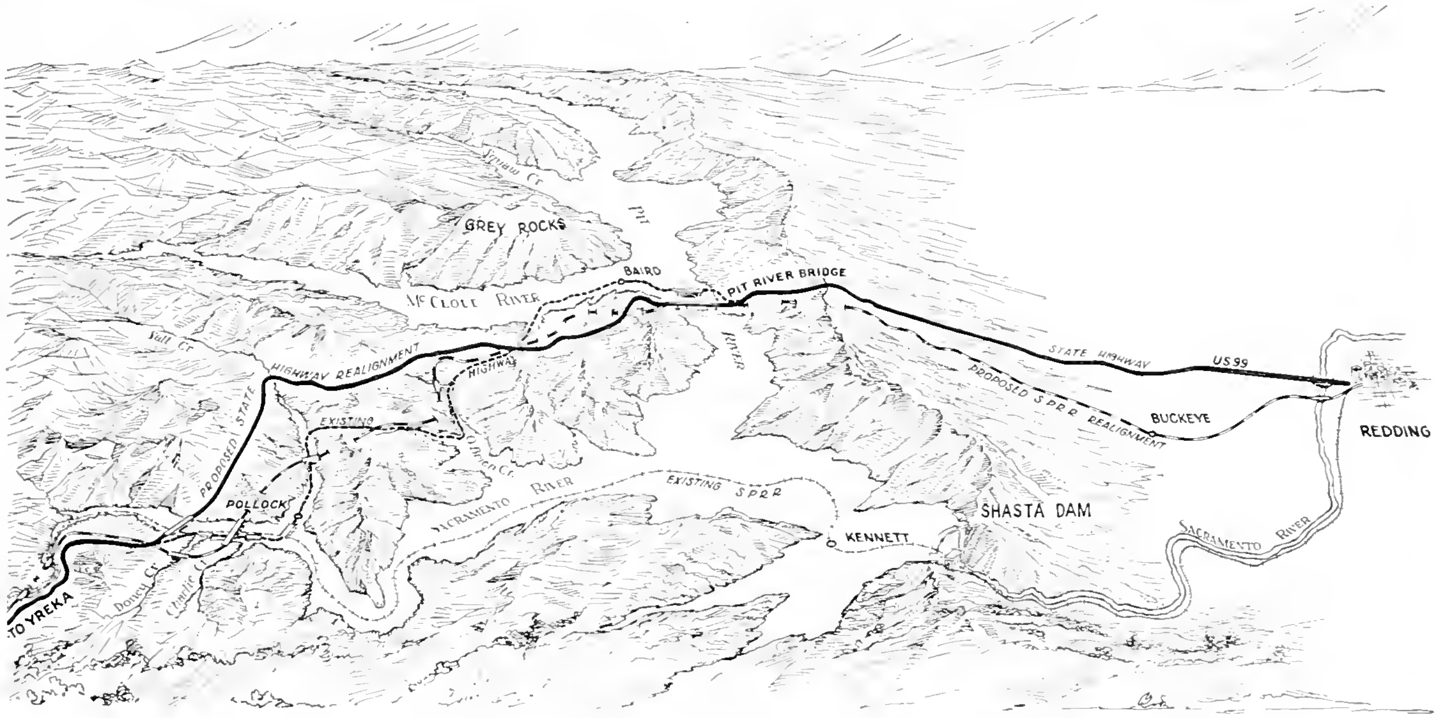
It is now estimated that the Pit River Bridge will be completed in the early part of 1942. This bridge, one of the largest of its kind, 3,467 feet in length, will carry both highway and railway traffic. The bridge construction is under the supervision of the United States Bureau of Reclamation, and title to it will be vested in the Federal Government, joint maintenance only being the responsibility of the State and the Southern Pacific Company. The existing highway bridge will be covered by 335 feet of water when the reservoir lake is formed.

In the 4-mile unit between Bass Hill and O'Brien Summit, composing one contract, some of the heaviest and most difficult grading work undertaken by the Division of Highways in Northern California, was encountered. The northerly one mile of this unit required excavating and moving approximately 683,200 cubic yards of material.

In one single cut in this section, the cut slope intersected the original ground surface 275 feet above the roadbed grade. In the adjacent fill, just northerly from the above cut, the embankment toe is 285 feet below grade, a total elevation differential of 560 feet. The largest cut contained 193,000 cubic yards. A total of 1,376,000 cubic yards of material was excavated on this unit.

This contract also included the construction of a reinforced concrete viaduct along a steep hillside. This bridge with an overall length of 395.5 feet, consists of one 23.5-foot and three 20-foot flat slab end spans; the main portion is of deck girder type of rigid frame design, composed of two 16-foot cantilever spans and five 56-foot spans, supported upon column bents. The deck width provides for three lanes of highway traffic.

The adjoining unit, and a separate contract, between O'Brien Summit and Antler, exclusive of the Antler



Map showing relocation of State Highway (U. S. 99) from Redding north around and across Shasta Dam Reservoir

Pit River Bridge as seen today from U. S. 99 with the gap half closed between the great central piers and only another half span to be completed. In the foreground is the existing concrete bridge that will be submerged 335 feet under water

On the mountainside high above the present road has been built the approach to the top deck of the bridge that will carry the relocated highway. The railroad approach is made through a tunnel to the lower deck

Bridge, involved 8 miles of grading. Approximately 1,540,000 cubic yards of excavation were involved in this project.

In this unit there were installed 10,452 lineal feet of pipe underdrains and 11,140 lineal feet of pipe culverts. Heavy grading and the presence of many springs made an extensive program of subdrainage necessary. A winter of record rainfall probably developed the maximum of ground water ever to be expected and exposed the locations where seepage would develop trouble.

The culvert pipes ranged in diameter sizes from 18 inches to 105 inches. The reinforced concrete arch culvert installed in Salt Creek, 187 feet in length, with inside span width of 16 feet and a vertical clearance of 20 feet, is considered one of the largest of its type in service in the State Highway System.

General statistical cost data on the highway relocation work completed to date, exclusive of the Pit River Bridge, is as follows:

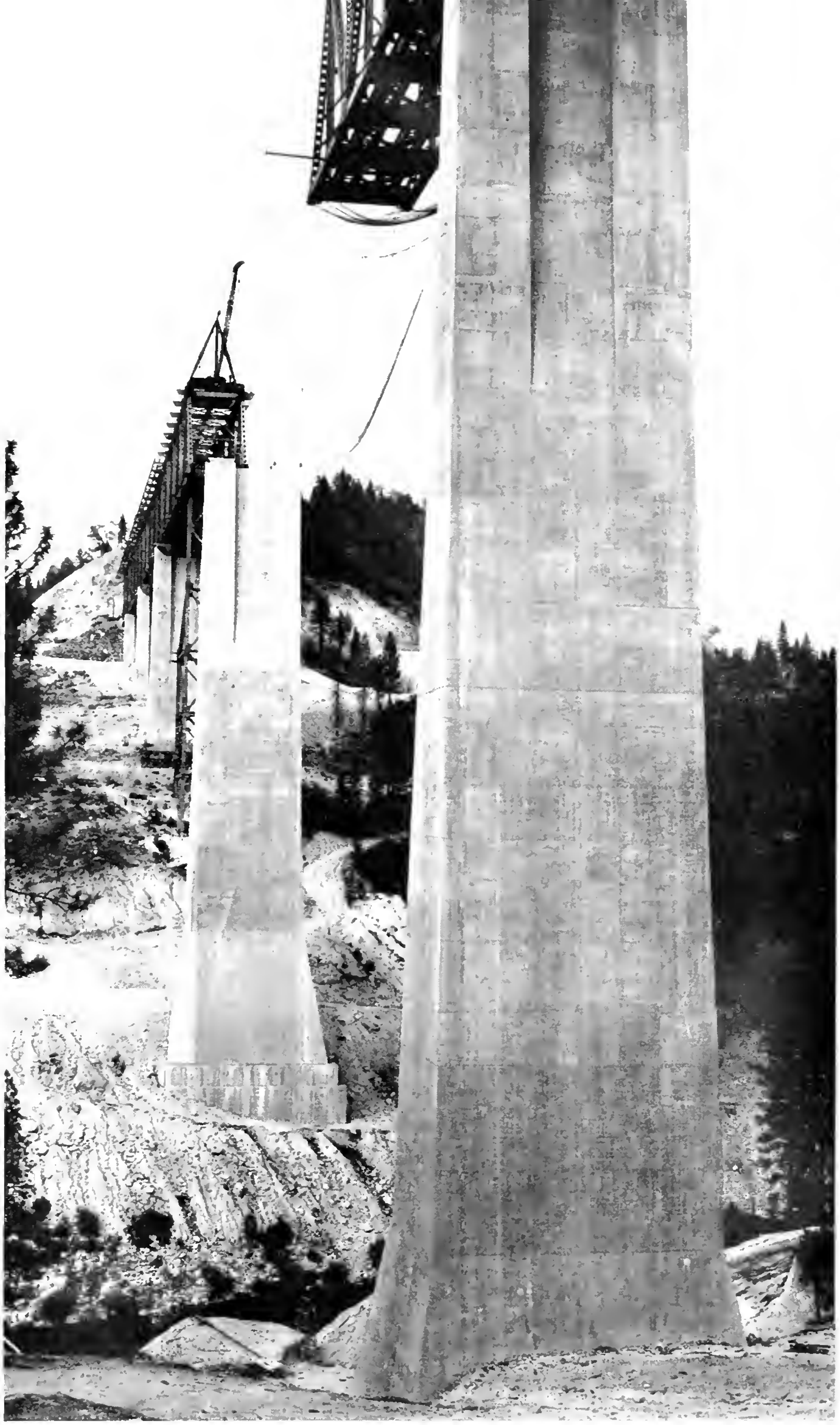
Antler to Crespos, 2.5 miles grading and surfacing, U. S. B. R. contract	$157,500
Bass Hill to O'Brien Summit, 4 miles grading, including the reinforced concrete viaduct	484,000
O'Brien Summit to Antler, 8 miles grading	453,000
Antler Bridge, 1330 feet in length	680,000
Total	$1,774,500

The greater portion of the cost of the highway relocation will be borne by the United States Government. The State is contributing an amount determined from the value of the improved standards of design to which the road is being constructed. The improvement in design consists largely in greatly improved alignment and a wider roadbed. Incidental to the relocation there was a decrease in gradient and in adverse grade.

With the completion of the grading work, the State has called for bids on the surfacing.

Two of the grading contracts and the contract for construction of Antler bridge were awarded by Director Frank W. Clark of the Department of Public Works for the State Division of Highways.

The work of this relocation, under contract by the State, has been under the supervision of the writer as Resident Engineer.



The middle piers of Pit River Bridge shown in foreground are 360 feet high, as tall as a 28 story building

Procession of cars at dedication ceremonies of realigned Mustang Ridge unit on State Sign Route 198 in Monterey County

94 Mustang Grade Curves Abolished

By E. J. L. PETERSON, District Office Engineer

ANOTHER link of the Sierra-to-the-Sea Highway, State Sign Route 198, located in Monterey County between Peachtree Valley and Mustang Ridge, about 15 miles east of San Lucas, was recently completed and officially dedicated September 15th.

The improvement is on entirely new alignment which was adopted after considerable study and laboratory investigation. This route crosses a very unstable terrain which is due, primarily, to its being traversed by the San Andreas fault with minor branch faults and numerous old slides and potential slide and slip areas.

The new alignment replaces a section of practically unimproved sidehill contour, old-time wagon road, with many short sharp curves and grades up to 8.3%.

The benefits gained by this construction are clearly illustrated by the following comparison of standards of the old and new highways and the map showing the location of the project:

	Old Highway	New Highway
Length	6.3 miles	4.6 miles
Number of curves	123	29
Total curvature	7271°	1354°
Minimum radius	60′	300′
Maximum grade	8.3%	7.5%

It will be noted that there is a saving in distance of 1.7 miles and an elimination of 94 curves with a reduction of total curvature of 5,917 degrees, a saving of over 16 complete circles. The minimum radii of curves has been reduced from 60 feet to 300 feet.

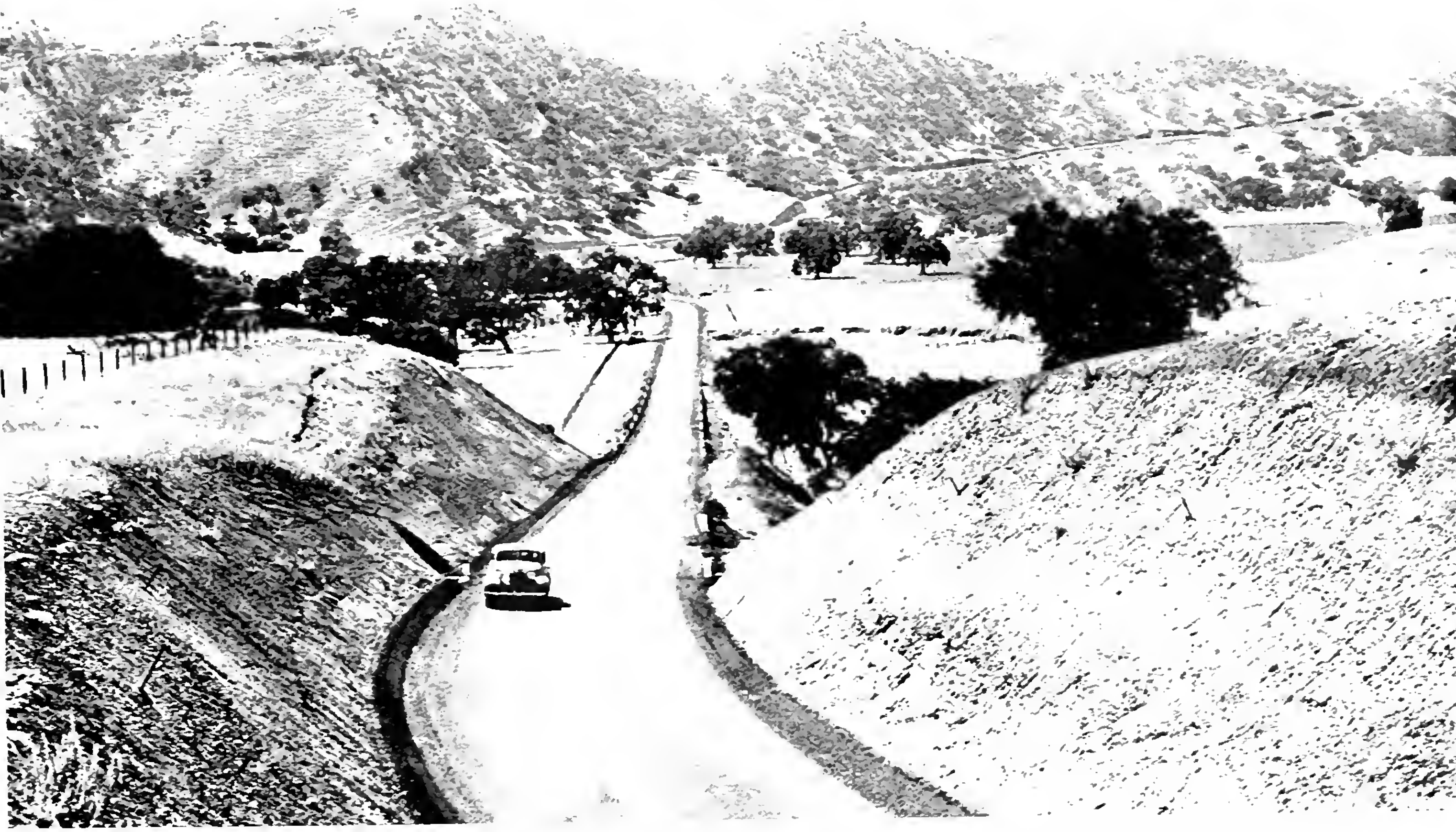
The new road throughout this section consists of a 21 foot graded roadbed with imported borrow 0.75 foot thick over the full width of the roadbed with a bituminous surface treatment of 0.25 foot thick over the full width of the roadbed.

Where questionable foundations for embankments were encountered, trenches were excavated through the unstable material to drain and stabilize the foundations. The trenches were 10 feet in width at the bottom and varied from 5 to 30 feet in depth.

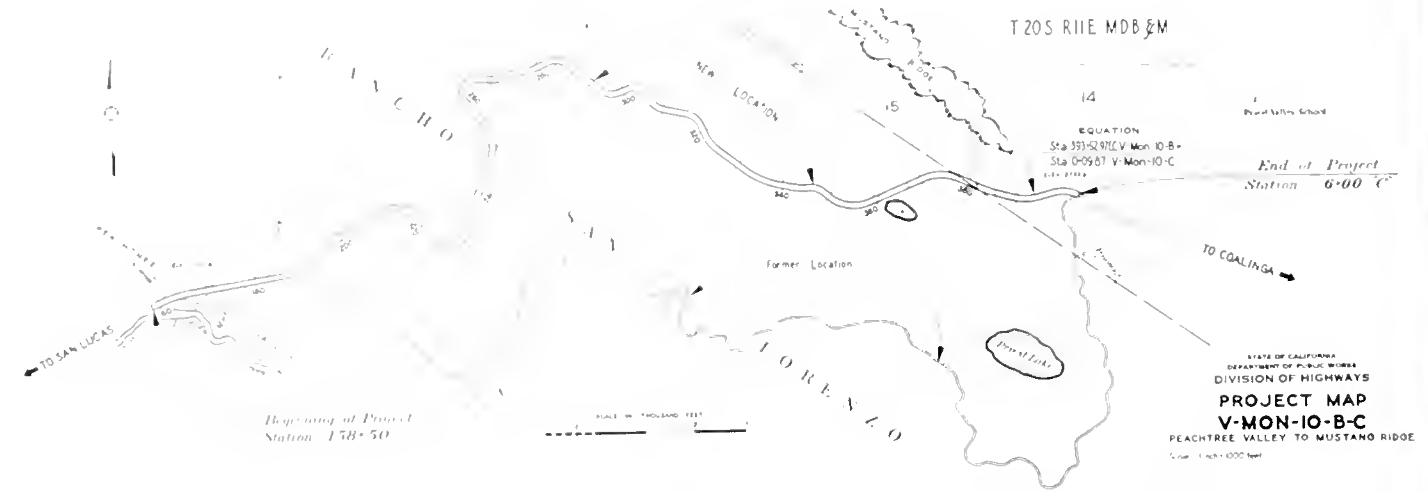
In order to take care of the seepage crushed rock was placed at the bottom of the trenches to a thickness of from 2½ to 5 feet with a mat of straw to prevent earth from sifting into the rock when placing the overlying embankment. Crushed rock was also spread on the trench side slopes where seepage was indicated.

The remainder of the trenches was then backfilled with earth. Where sufficient seepage was encountered to warrant their installation, 8 inch perforated metal pipes were placed in the bottom of the trenches.

Added protection against embankment failure was afforded by the construction of toe supports along the embankments of material exca-



Two views of improved sections of realigned Mustang Ridge route through mountains separating San Joaquin and Salinas Valleys where a narrow old road with 123 sharp curves in 6.3 miles has been replaced by a 21-foot highway with 23 easy curves



Sketch map of tortuous old Mustang Grade route of 123 curves compared with new highway

vated from the trenches and roadway.

Unstable cut slopes were benched to unload the slope or constructed on a flat 2:1 slope. As a result of these precautionary measures, only minor slides have occurred in this generally unstable material even though the precipitation during the past abnormal winter was more than twice the average rainfall.

The rock filling material placed in the fill treatment trenches and the imported borrow used for constructing the upper portion of the roadbed were produced from a local deposit of chert adjacent to the roadway.

The work involved approximately 317,000 cubic yards of roadway excavation; 20,000 cubic yards of trench excavation for fill treatment; 5,000 cubic yards of rock filling material; 33,000 tons of imported borrow; 650 tons of liquid asphalt and 72,000 square yards of mixing and compacting surfacing.

The contractor was Harms Brothers and the cost approximately $175,000.

The dedication and formal opening ceremonies were held at a beautiful spot in Peachtree Valley. George Gould of Salinas, president of the Sierra-to-the-Sea Highway Association, was master of ceremonies and the speakers included Leo J. Smith, special representative of Director of Public Works Frank W. Clark; J. W. Halleen, representing the State Chamber of Commerce; Fay McCollum and Floyd E. Howe, Coalinga Chamber of Commerce; Fred McCarger, Salinas Chamber; Craig Cunningham, Madera Chamber and W. C. Beasley, King City Chamber.

A telegram was received from Governor Culbert L. Olson, expressing his regrets at his inability to attend the ceremony.

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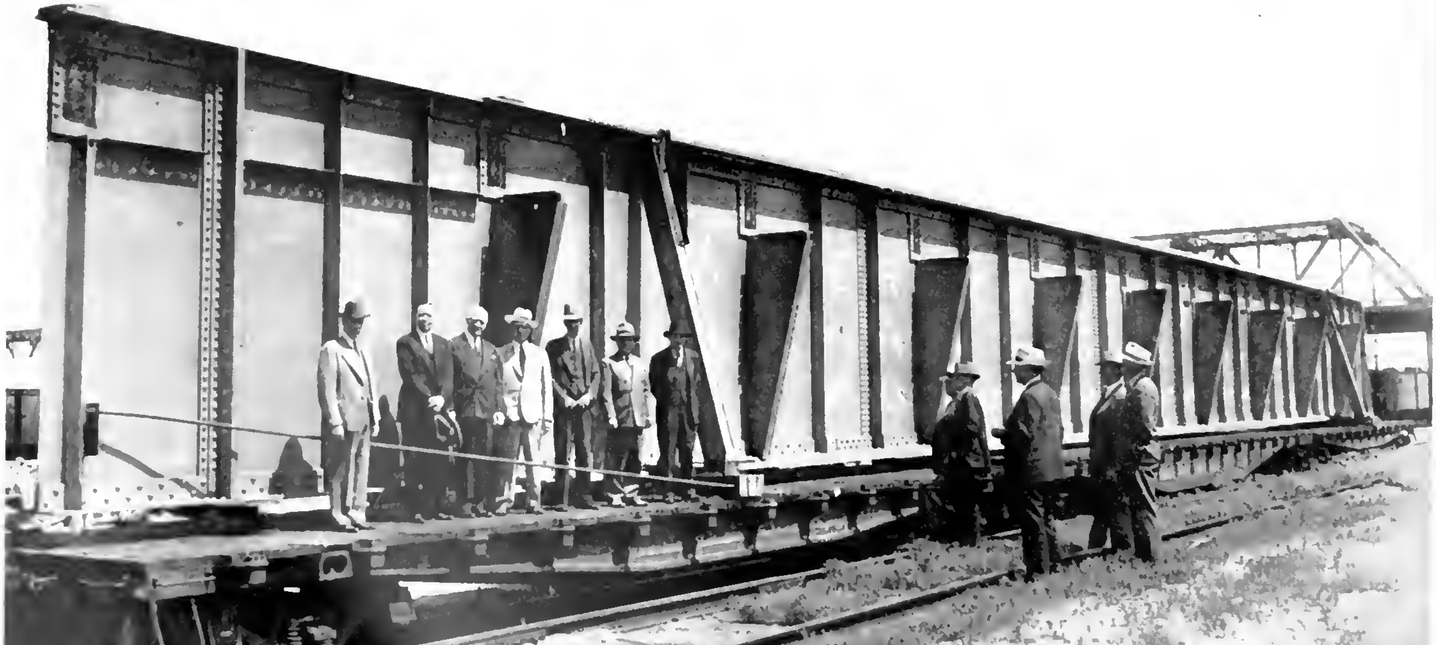

Officials inspect huge girder of Pit River Bridge that required 3 freight cars to transport (see article on page 3)

New Laws Effective Jan. 1, 1942 Covering Gross Weights of Vehicles on Highways

By STEWART MITCHELL, Assistant Bridge Engineer

IN order to clarify the revised provisions covering the gross weight of vehicles in the California Motor Vehicle Code (AB 1268) the following discussions and examples of their application to existing vehicles have been prepared. The revisions recently made by the legislature which are to take effect January 1, 1942, were necessary because the present law does not properly regulate the weight of vehicles in conformity with the safe carrying capacities of standard highway bridges built in accordance with the so-called "H-15" design load which has been in general use all over the United States during the past 15 or 20 years.

Since it is obviously impractical to replace these bridges, it is necessary to limit the actual vehicle loads in a way that will not shorten their service life or increase the cost of maintenance unreasonably.

The allowable stress in the structural members of a highway bridge is a function of the weight and spacing of the axles. Some of the axle concentrations of certain types of vehicle are too great for safety while in the case of other vehicles it is safe to permit a slightly greater gross weight than is now allowed.

WEIGHT FORMULA ADOPTED

The method that has been adopted to regulate the gross weight of vehicles in accordance with axle loads and spacings has been given careful thought for a good many years. The particular type of formula C (L+40) that has been incorporated into the Vehicle Code was first included in a code of recommended practice for regulating the size and weight of motor vehicles adopted by the American Association of State Highway Officials in 1932. In 1937, the Western Association of State Highway Officials, comprising the representatives of the eleven Western States, adopted more definite rules specifying in detail the application of the formula and setting exact values for the coefficient.

As the result of studies made by the Division of Highways subsequent to 1937, in which many of the Engineers of the trucking industry cooperated, slightly higher values for the coefficient than those adopted by the Western Association were decided upon as being reasonable under the conditions encountered in California. However, the engineers of the Division of Highways feel that the values so adopted permit the greatest loads that can be allowed without cutting down the safety factor to a degree beyond which it is not safe to go under conditions of continuous service.

APPLY TO NEW VEHICLES

It was generally agreed by those who had given the matter careful study that the permanent limitations imposed in Section (a) and (b) of the Code would be satisfactory provided they were applied to a new vehicle only. In the case of some vehicles already constructed in accordance with the old law which can not economically be modified so as to get the axle spacing required, a strict application of the 18-foot limit would reduce the gross weight out of proportion to actual increase in stress produced by the small decrease in axle spacing.

Exceptions were made (Sections (c) and (d)) to take care of such vehicles and a ten-year period allowed for the owner to get back his investment. Therefore these additional complications in the law are temporary and are required in order not to unnecessarily penalize those who have constructed and purchased their vehicles in good faith.

The previous weight restrictions of the California Vehicle Code placed an arbitrary weight limit on each type of vehicle or vehicle combination. In many respects the loads allowed on the various vehicle types did not conform to the stresses produced in highway structures. Even more detrimental to highway structures was the fact that the allowed load on any particular type remained unchanged regardless of the vehicle's length.

Short-coupled vehicle combinations induce high stresses in bridge structures, while if the same load is distributed over a longer wheel base the stresses are appreciably reduced. A logical weight restriction must base the allowed load on the length of wheel base over which this load is distributed.

WHEEL BASE PRIMARY FACTOR

The new law covering vehicle weights, which becomes effective on January 1, 1942, is based on this principle. The arbitrary weight limits for the various vehicle types are discontinued and the allowed load on all vehicles and vehicle combinations placed on as nearly equal footing as is practicable. The load to be allowed on any vehicle type will depend primarily on its wheel base, subject to the maximum allowed axle and wheel loads, and the weight concentrations which may be carried on any group of closely spaced axles.

The new law which is effective on all vehicles first registered after January 1, 1942, and on all vehicles regardless of their date of registration after January 1, 1952, may be stated briefly as follows:

GROSS WEIGHT LIMITS

Sec. 704: "The gross weight imposed upon the highway by the wheels of any one axle of a vehicle shall not exceed 18,000 lbs. and the gross weight upon any one wheel or wheels supporting one end of an axle and resting on the roadway shall not exceed 9,500 lbs."

Sec. 705 (a): "No vehicle, whether operated singly or in a combination of vehicles, and no combination of vehicles shall be operated whose gross weight, with load, exceeds that given

(Continued on page 17)

Two Units of Coast Road West of Santa Barbara Under Reconstruction

By LESTER H. GIBSON, District Engineer

WEST of the City of Santa Barbara the State Highway coast route leading northerly toward San Francisco follows the ocean shore for some 20 miles between Ellwood and Gaviota Canyon. Since the early days of road construction in California traffic heading northerly has used the road facilities along this route.

With the development of the present State Highway System this section was graded in 1914 and about 1919 a portland cement concrete pavement 15 feet wide and 4 inches thick was placed over most of the distance. To meet the needs of increased traffic flow the old pavement was later surfaced with an upper story of asphalt concrete and the pavement widened with portland cement concrete borders.

During recent years there has been much improvement of the coast route in Santa Barbara County. South of Santa Maria this main route between Los Angeles and San Francisco was constructed on modern alignment through Solomon Canyon, in 1931 and 1932.

In the City of Santa Barbara and southerly through Montecito the highway has been constructed as a modern divided arterial.

Complete reconstruction has been accomplished through Gaviota Canyon 35 miles west of Santa Barbara and the Nojoqui Creek line change north of the canyon provided a marked improvement.

On the coastal section between Santa Barbara and Gaviota Canyon several of the poorer sections have been reconstructed and last year work was begun on two of the three remaining portions which were in need of improvement to meet modern traffic requirements.

On August 10, 1940, the Director of Public Works awarded a contract for the reconstruction of 3.4 miles of this route between Tecolote Creek and Las Varas Creek, approximately 12 miles west of Santa Barbara. On September 13, 1940, a separate contract was awarded for construction of a new reinforced concrete girder bridge across Dos Pueblos Creek within the limits of the road reconstruction contract.

Improvement to a second portion of the route was begun with the award on October 4, 1940, of a contract for construction between Orella and one mile west of Canada del Refugio, a distance of two miles, some 20 miles west of Santa Barbara, including the construction of a new concrete girder bridge across the Canada del Refugio.

Traffic using the route has varied from an average of 2,000 cars per day in the winter months to 6,000 in the summer, with particularly heavy concentrations on Sundays and holidays, as recreationists sought the Santa Barbara beach areas. For this volume, the alignment, grade, and surface on both of these sections were considerably substandard.

At Dos Pueblos Creek, Eagle Creek, and Refugio Creek, the bridges provided narrow roadways only 21 feet in width and, in the case of all three bridges, curvature at each end presented hazardous conditions. At many locations on each section the grade line was such as to seriously restrict sight distance.

The designs for both new sections were made to eliminate these obsolete

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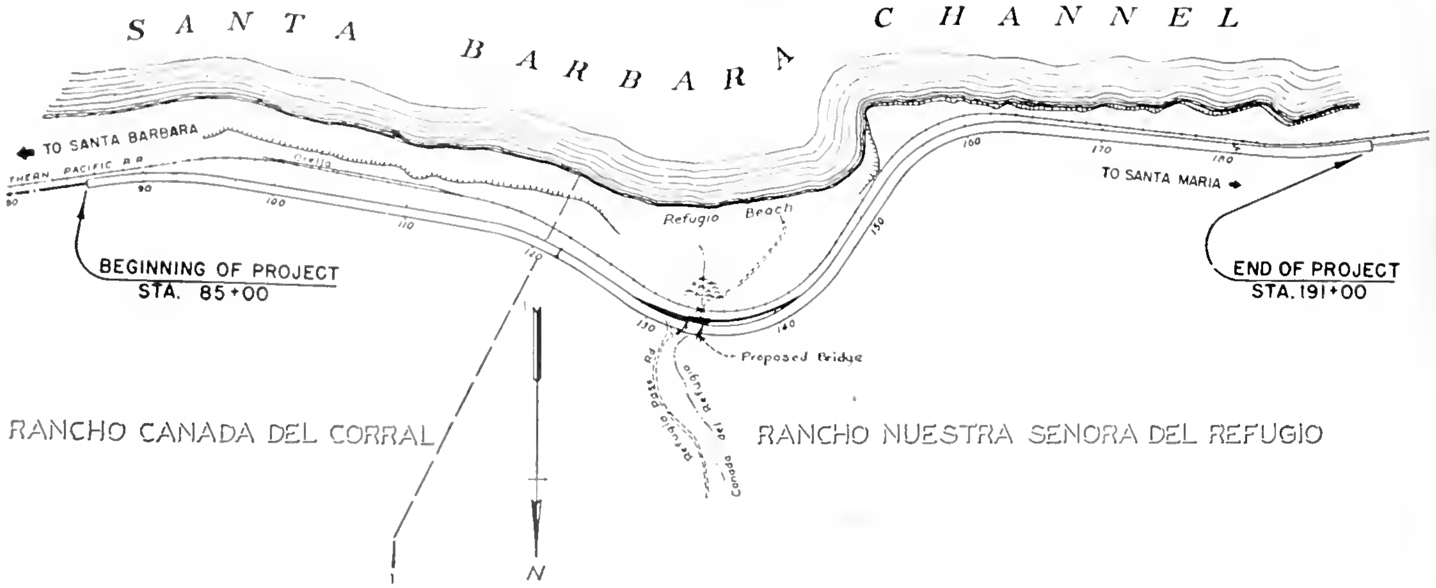
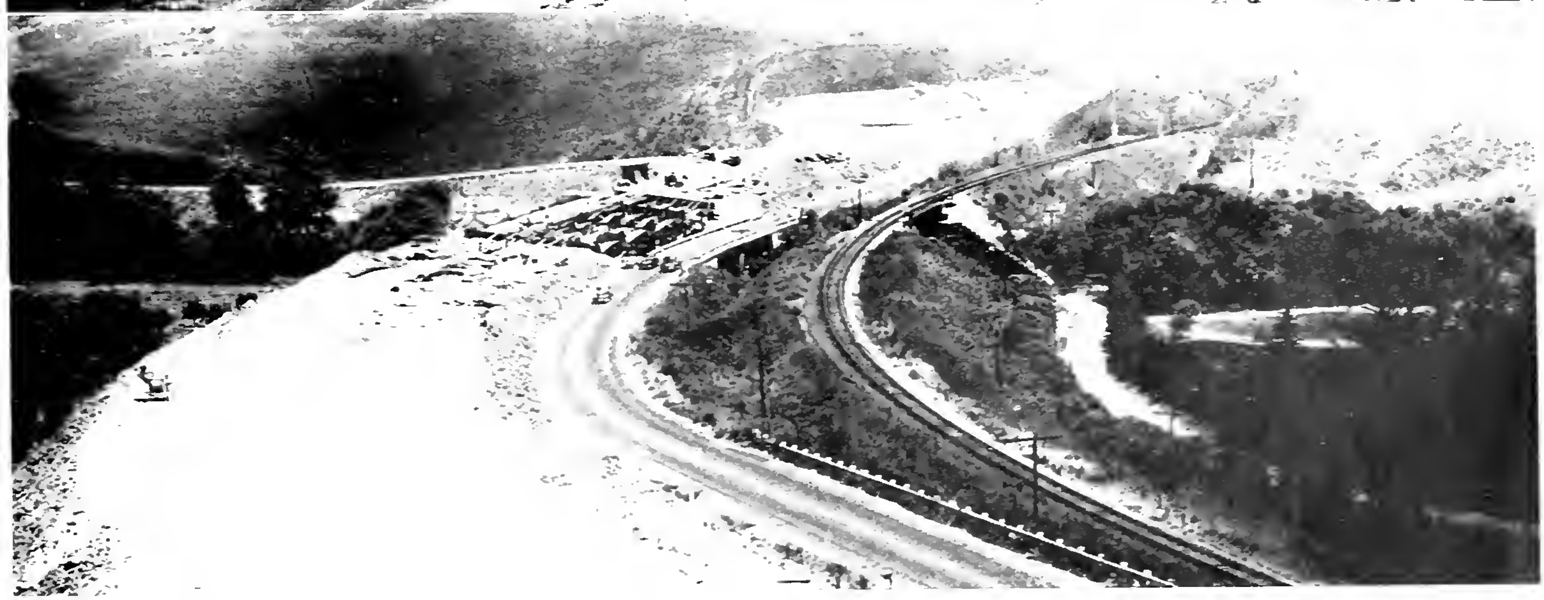


Map showing section of Coast Highway under reconstruction west of Santa Barbara between Orella and Canada del Refugio



Views of reconstruction on Coast Highway west of Santa Barbara. Top and bottom scenes show Canada del Refugio bridge under construction. Here a 4-lane realignment on a fill eliminates a long old and narrow old structure with restricted sight distance

A reinforced concrete box culvert carries Tecolote Creek under highway

features. The comparative tabulation between the old and new sections of highways clearly indicates the improvements effected by the reconstruction.

	Tecolole Creek to Las Varas Creek		Orella to One mile West Canada del Refugio	
	Old	New	Old	New
Total number of curves	8	4	10	4
Total curvature	146	63	210	211
Minimum Radius	358 ft	5000 ft.	700 ft.	1000 ft.
Maximum Grade	6.5%	3.1%	6.8%	3.9%
Minimum vertical sight distance	320 ft	1400 ft	320 ft.	875 ft.
Minimum horizontal sight distance	240 ft	900 ft.	360 ft.	475 ft.

In the design of the section between Tecolote Creek and Las Varas Creek the new standards of construction are those for a high type of two lane thoroughfare. On the Orella portion of the route, however, the read at Canada del Refugio was so restricted beween the location of the railroad on the ocean side and the rapidly rising hills on the north, that the cost of necessary heavy grading for construction to similar standards of curvature was such that it was found more expedient to somewhat reduce the standards of alignment and construct the road as a four-lane divided highway.

That soil conditions throughout both of these sections are poor has long been evidenced by the difficulty and high cost of shoulder maintenance on the old road. To overcome this handicap the new construction consists of placing a heavy blanket of satisfactory imported material on which is placed a cement treated base six inches thick. The surfacing placed on top of this base consists of a bituminous plant-mixed crushed rock three inches in thickness. The shoulders, constructed of salvaged surfacing, are also surfaced with plant-mixed surfacing.

On the two lane sections, the roadway is graded 36 feet wide, the cement treated base is 24 feet wide and the surfacing is 22 feet wide. On the four lane portions the graded roadbed is 64 feet in width, the treated base 50 feet wide and the surfacing 50 feet.

Construction operations on the contract between Tecolote Creek and Las Varas Creek involved 360,000 cubic yards of excavation and the contract between Orella and Canada del Refugio necessitated 160,000 cubic yards of excavation.

The bridge across Dos Pueblos Creek was built under a separate contract and was completed on March 28, 1941. This reinforced concrete girder structure consists of one 60-foot and two 50-foot spans on concrete piers and abutments. The bridge provides a 27-foot clear roadway.

The old narrow bridge across Eagle Creek was replaced by a reinforced concrete arch culvert which was built under the road contract.

The new bridge across Refugio Creek is a reinforced concrete girder structure consisting of two 36-foot spans, two 40-foot spans and two 9-foot cantilevers, all on concrete bents with timber pile foundations. This bridge, which is located in the four-lane section of highway, provides a 56-foot roadway.

It is estimated that the road contract between Tecolote Creek and Las

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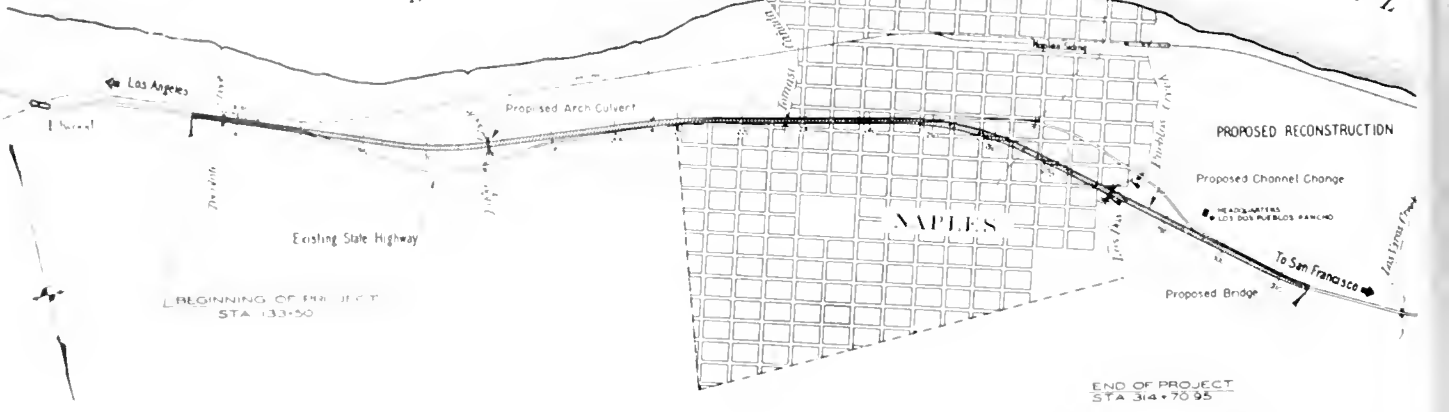


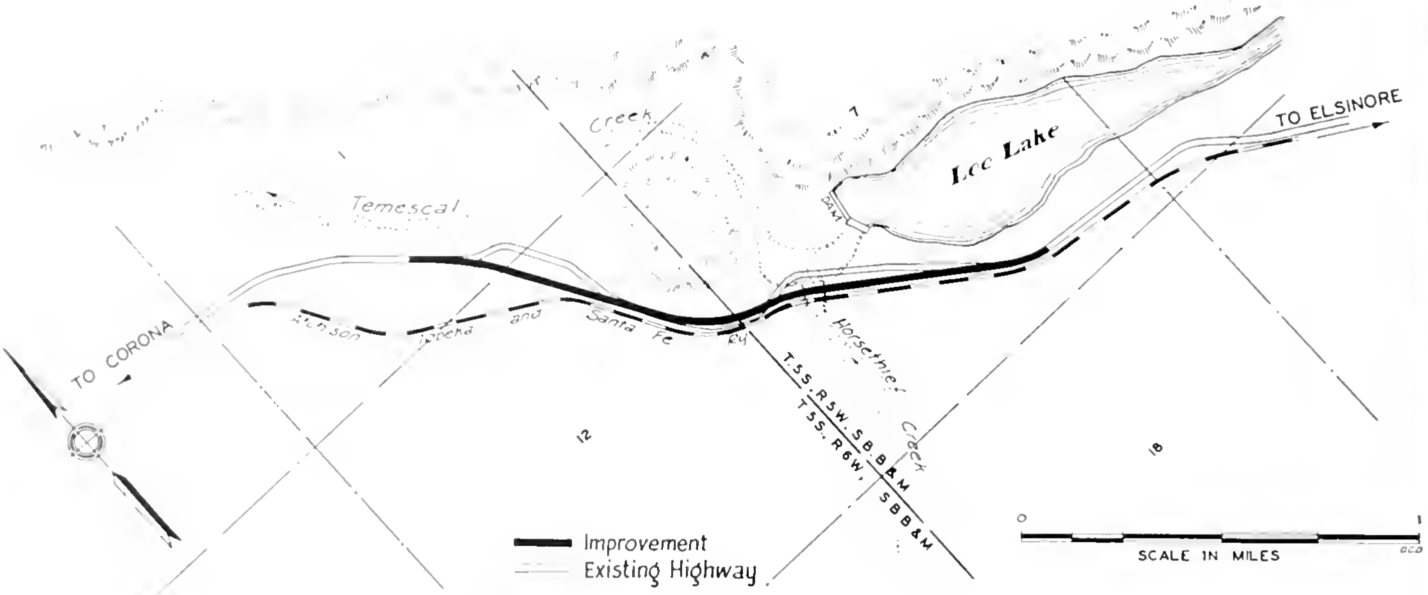
Top—Rough graded section of realignment of Coast Highway west of Santa Barbara. Center—Cut slopes being rounded preparatory to application of top soil. Bottom—Top soil applied and left rough to permit natural vegetation to gain a foothold

Flood Damaged Highway in Temescal Canyon Rebuilt on New Alignment

By A. E. SMITH, Assistant Engineer

RECONSTRUCTION of a section of highway ravaged by the flood of March, 1938, is virtually complete on a portion of the "Inland Route" between Corona and Elsinore in Riverside County.

As a result of the abnormal rains in March, 1938, and the excessive runoff, in which much of Southern California suffered severe damage, Temescal Creek carried a huge volume of water.



Sketch of realignment in Temescal Canyon. Heavy black line shows location of new road compared with old

This creek was the source of water supply for Lee Lake located in the Temescal Canyon. As the spillway facilities of the lake were inadequate for so large a volume of water, during the flood stage the dam broke, causing a portion of the highway to be washed out.

Temporary detour roads were constructed of oil mix around the new wash area and traffic was permitted to travel uninterruptedly without inconvenience.

In the reconstruction of the permanent road, a new alignment was chosen southerly of the old road, hugging The Atchison, Topeka and Santa Fe Railway as closely as possible. This was to improve the alignment, and to place the highway farther from the reaches of Temescal Creek.

The job was 1.67 miles in length and consisted, in general, of constructing a graded roadbed 36 feet in width covered with a four-inch thickness of road-mix surface treatment. The surfacing provides for two standard 11-foot lanes for traffic and a seven-foot shoulder on each side of the traveled way portion.

CONCRETE GIRDER BRIDGE

Selected material was placed 12 to 18 inches in thickness throughout the project, the top four inches being used as aggregate for road-mixing.

Berms at the top of fill slopes and gutter ditches adjacent to the cut slopes were also paved with the oiled surfacing material.

A reinforced concrete girder bridge was constructed across Horsethief Creek, tributary to Temescal Creek. The junction of the two streams is immediately below the bridge.

The bridge was built on steel pile bents and consisted of four interior spans of 22 feet, six inches each and two exterior spans of five feet each. The approach fills were protected by placing sacked concrete riprap under the bridge around the ends of these fills.

Protection work was further performed by placing broken concrete riprap along exposed embankment slopes. The broken concrete was obtained from adjacent sections of old concrete pavement damaged by the flood.

The remains of the old concrete bridge across Horsethief Creek were broken up and disposed of, as well as other portions of concrete that would present an unsightly appearance from the new road.

At locations where spring water was encountered a system of perforated metal pipe underdrains was installed to prevent subgrade saturation. Approximately 1,350 lineal feet of underdrain pipe were used.

Other phases of the work consisted of placing corrugated metal pipe culvert cross-drains and a 10 by 6 by 94 foot reinforced concrete box culvert, encasing irrigation lines with concrete jackets to insure against damage by saturation to the highway; moving and resetting property fences and incidental work.

This was a Federal Aid Project. The work was done by State Highway contract. The firm of Oswald Bros. of Los Angeles was the contractor. The bridge construction was performed by Oberg Bros. under a subcontract. Mr. W. H. Crawford was the Resident Engineer.

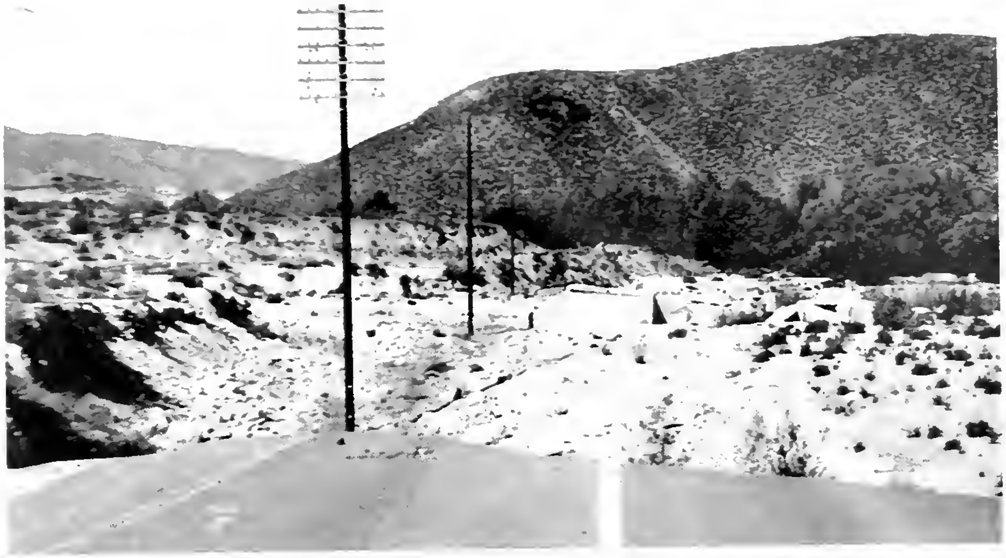
Passenger Buses Serving Increased Needs of Defense

Reports from public passenger bus operators in many sections of the country indicate that this mode of transportation is providing greatly increased services in National defense.

One company serving a large military reservation reports a 255 per cent increase in passengers for the first five months of 1941 over the same period in 1940. The same line during May, 1941, carried increased business of 456 per cent over 1940.

In addition to serving Army, Navy and Marine reservations, buses are supplying transportation to airplane factories, steel mills, housing projects, arms factories, ship yards, shell loading depots, munitions plants and other defense activities.

There are 2,209,856 automobiles on 2,825,126 farms in the first twenty-four states tabulated in the 1940 farm census conducted by the Bureau of the Census, United States Department of Commerce. The percentage of farms having automobiles, not including trucks, in these 24 states is 74.2, although Iowa with 236,601 automobiles on 213,318 farms had 90.2 per cent.



At top—View showing how old highway was washed out by flood waters in 1938 due to failure of Lee Lake Spillway. Center—New highway. Bottom—New bridge replacing old bridge seen in foreground of top picture.

Newly completed divided highway south of Madera. Roadside trees of old road preserved as screen on division strip

New Divided Highway Units on U. S. 99

By R. E. PIERCE, District Engineer

PROGRESSIVE highway improvements made in the past three years are providing vastly increased capacity and safety for the heavy traffic using U. S. 99, State Route 4, in Stanislaus and Merced Counties.

This traffic, ranging from 7,000 to over 10,000 vehicles per day, with a large number of trucks, greatly exceeds the capacity of the existing 20-foot pavement.

At the same time, a serious flood hazard was eliminated in Merced and northern Madera counties.

The problem of relieving this condition is being solved by providing, in general, an additional 23-foot portland cement concrete pavement separated from the existing pavement by a dividing strip, except through cities where widening and improving existing pavements has been accomplished.

Completed divided highway projects in the two counties are:

Completed	Description	Length of Project	Length of Divided Highway	Cost of Project
Jan., 1939	Modesto northerly to Salida	5.76 mi.	5.48 mi.	$208,000
	(Landscaping)			11,000
June, 1939	Merced southerly	5.70 mi.	5.42 mi.	355,000
Oct., 1939	Merced northerly	1.74 mi.	1.43 mi.	177,400
Work Began	**Projects now under construction**			
Feb., 1940	In Merced and Madera Counties	4.39 mi.	4.14 mi.	251,600
Oct., 1940	Hatch Crossing south, Modesto to Keyes	5.51 mi.	4.64 mi.	230,900
	Totals	23.10 mi.	21.11 mi.	$1,233,900

Mileages of different widths, etc., extending from 1.792 miles south of northerly boundary of Madera County to northerly boundary of Stanislaus County.

Mileage of two-lane State Highways	32.645
Mileage of three-lane State Highways S. Modesto	1.316
Mileage of four-lane divided State Highways	21.11
Mileage of city streets	8.104
Total Mileage	63.175

The incentive for the first project extending northerly from Modesto to Salida, a distance of 5.76 miles, initiated in May, 1938, and completed in 1939, was the necessity for better facilities for the more than 10,000 vehicles using this road daily. A portion of this project included the widening of a short piece at the north end of 9th Street within the City of Modesto, and a short transition section at Salida, which leaves a net of 5.48 miles of divided highway.

This project provides for northbound traffic an additional two lanes of portland cement concrete pavement 23 feet in width, separated from the existing 20-foot pavement carrying southbound traffic by a strip averaging 29 feet in width. This permits the existing trees to remain in place, giving the added advantage of a protecting screen to opposing automobile headlights at night.

The approximate total cost of the project was $208,000. In addition, an extensive landscaping project, including the planting of many trees and shrubs was completed at a cost of approximately $11,000.

FLOOD PROBLEM SOLVED

The next project to be constructed —started May, 1938, and completed June, 1939—was the divided highway south of Merced. This was initiated primarily to solve a flood problem which had caused great inconvenience and hazard to traffic on this section during periods of high water ever since it was built. Also the traffic of over 7,000 vehicles per day justified additional facilities.

This project, 5.70 miles in length, consists in the main of a 23-foot width, two-lane portland cement concrete pavement carrying the northbound traffic, with a separation of 21 feet from the old two-lane, 20-foot

Divided highway unit of U. S. 99 nearing completion south of Modesto with traffic using outside lanes

Divided highway under construction between Merced and Chowchilla on U. S. 99. The contract included construction of a bridge over Chowchilla River

pavement carrying the southbound traffic.

The elimination of the flood hazard was accomplished by building the new pavement upon an embankment high enough to clear any flood of record. The old road was also protected from floods by carrying cross levees from the new grade to the Southern Pacific Company embankment at the bridge ends.

The total length of divided highway amounts to 5.12 miles, 0.28 miles of the 5.70 total mileage being taken up in transitions at each end.

The completed work cost approximately $355,000.

The next divided highway project, from Merced north to Black Rascal Creek, a distance of 1.74 miles, started in October, 1939, and completed in August, 1940, was proposed for the same reason as the previously described project, with the object of getting the new pavement above flood waters, which frequently in the past entirely stopped traffic on the old road. Also, the 7,000 or more vehicles per day using the road justified additional facilities.

The work, in general, consisted of grading; portions to be paved with portland cement concrete; portions to be surfaced with plant mixed surfacing on portland cement concrete base and untreated crushed gravel or stone surfacing as a base; borders and widening strips to be constructed adjacent to the new pavement consisting of plant mixed surfacing on untreated crushed gravel or stone surfacing as a base; and reinforced concrete bridges to be constructed.

A portion of the project is on 16th Street, about 187 feet being within the city, and some 1,000 feet of widened section outside the city and south of Bear Creek. About 660 feet is used in merging into the present pavement at the north end of the project, leaving 1.43 miles of divided highway.

FOUR BRIDGES BUILT

As stated, the new grade was elevated about 5 to 6 feet above the average ground level to clear the highest flood waters of record.

The new concrete pavement 23 feet in width, laid in two lanes, the outside being 11 feet wide, and the inside being 12 feet in width.

The project included four concrete bridges: Two over Bear Creek; one over Black Rascal Creek; and one for overflow between the two creeks.

The two bridges over Bear Creek are both skewed to the stream, and also are not parallel, as their location between the special widened dividing strip at the intersection with State Highway Route 123 to Snelling and 16th Street made it advisable to build the bridges not parallel but diverging

(Continued on page 20)

New Laws Effective Jan. 1, 1942 Covering Gross Weights of Vehicles

(Continued from page 7)

by the formula W=800 multiplied by (L+40). In said formula W equals the total gross weight, with load, in pounds; L equals the distance in feet between the first and last axles of the vehicle or combination of vehicles."

(b) "The total gross weight, with load, imposed upon the highway by *any two or more consecutive axles* of a vehicle, or of a combination of vehicles, where the distance between the first and last axles of said two or more axles is 18 feet or less, shall not exceed that given by the formula W=700 multiplied by (L+40). In said formula W equals total gross weight with load, in pounds, imposed on the roadway by the group of axles under consideration; and L equals the distance in feet between the first and last axles of the group."

TEN YEAR EXCEPTIONS

Manufacturers are taking, or will take, the above restrictions into account in designing new equipment after January 1, 1942, and a detailed discussion of this phase of the law will not be included. The chief purpose here is to acquaint owners with the changed restrictions covering existing equipment. In order not to effect too severe hardship on the owners of present equipment, exceptions to Sec. 705 (a) and (b) are included in the law and apply for a ten-year period.

These exceptions, which apply until January 1, 1952, on all vehicles first registered prior to January 1, 1942, and on all combinations of vehicles when each vehicle of the combination was first registered prior to January 1, 1942, are:

Sec. 705 (e). Exception to Sec. 705 (a) says that if "vehicles or combinations thereof have a distance of not less than 25 feet or more than 45 feet between the first and last axles of the vehicle or combination, the formula applicable to such vehicle or combination shall be W=850 multiplied by (L+40) but no such vehicle or combination of vehicles shall be operated whose gross weight with load exceeds 68,000 pounds."

Sec. 705 (d). Exception to 705 (b) says that if "vehicles or combinations have a group of two or more axles where the distance between the first and last axles of said two or more axles is between 14 and 18 feet, both inclusive," the formula applicable shall be W=800 multiplied by (L+40)."

The general points to be kept in mind in computing the allowable load on existing vehicles or vehicle combinations after January 1, 1942, are as follows:

AXLE AND WHEEL LOADS

The maximum axle load under the new law is 18,000 pounds. This is an increase of 1,000 pounds over that allowed at present and this increase will prove advantageous particularly to two-axle vehicles. However, *less leeway in lateral unbalancing of the load* is allowed under the new law since the maximum wheel load is 9,500 pounds.

The formula covering two or more axles within a distance of 14 feet is W=700 (L+40). This formula must be applied to determine the allowable load on: (1) dual axles, (2) on single vehicles whose wheel base is less than 14 feet, and (3) on any group of two or more consecutive axles of a vehicle or combination where the distance between said axles is less than 14 feet.

The spacing of dual axles only varies within narrow limits, from the minimum legal spacing of 40 inches to a maximum of about 5 feet. The allowable gross load on duals as represented by these limits is between 30,330 pounds and 31,500 pounds.

TRAILER COMBINATIONS

Although applicable to single trucks and tractors with a wheel base of less than 14 feet, this formula will not usually control since practicable considerations governing the load on the steering axle generally set the gross load at a value less than allowed by the formula. This formula will limit the allowable load on full trailers with a wheel base of less than 14 feet; and, in the case of truck-trailer combinations, usually should be applied to determine the gross load on the group of axles comprising the front trailer axle and the rear axle or axles of the towing vehicle. In the case of short coupled semi-trailer combinations, the rear tractor axle, or axles, with one or more axles of the semi-trailers may be included in a distance of 14 feet, in which case the formula 700 (L+40) will usually limit the allowable load.

It may be easier for some persons to remember or apply the formula if the mathematical form is changed. For example, the formula 700 (L+40) may be put in the form 28,000+700L. In words this means that the allowable gross load may be found by adding to 28,000 lbs., 700 lbs. for each foot of distance. The maximum for a single axle is, of course, 18,000 lbs., and the formula applies only to two or more axles of a group with a minimum allowable spacing of 40 inches. The most common spacing for dual axles is 3′ 9″, in which case their permissible load is: 28,000 plus the product, 3.75 times 700, or 30,625 lbs. Of course, the same answer results if 700 is multiplied by 43.75.

GREATER THAN 14 FEET

The formula W=800 (L+40) must be applied to existing vehicles to determine the permissible load on the following: (1) any single vehicle whose wheel base exceeds 14 feet and is less than 25 feet, (2) any vehicle combination whose total wheel base is less than 25 feet or greater than 45 feet and (3) any group of three or more consecutive axles of a vehicle or vehicle combination where the distance between said axles is between 14 and 18 feet.

In (2) above where the total wheel base of the combination exceeds 45 feet the exception of Sec. 705 (e) does not apply, since a combination whose wheel base exceeds 45 feet is permitted a gross in excess of 68,000 lbs., in accordance with Sec. 705 (a).

The reference in (3) above to 3 or more axles when the wording of Sec. 705 (b) is "two or more axles" requires explanation. Actually 2 axles require a distance of only 11.4 feet to enable them to carry the full legal maximum of 18,000 lbs. on each axle. Consequently, 3 axles or more must be contained within a distance of 14 to 18 feet before the formula becomes the limiting factor.

25 TO 45 FEET

Vehicles or combinations of vehicles whose total wheel base is between 25 and 45 feet are allowed a gross load

(Continued on page 24)

Clearing and burning Echo Summit site, Sept. 5

General view of work operations on Sept. 15

Fast Work on Construction of the Echo Summit Snow Removal Station

By J. L. PIPER, District Maintenance Engineer

THE California Highway Commission, on August 29th voted funds to construct maintenance quarters and equipment buildings and to purchase snow removal equipment for use at Echo Summit of the Sierras to keep U. S. 50 open throughout the winter. Full cognizance was taken of the fact that winter was fast approaching and that the need for immediate action was necessary in order to carry out the decision of the Highway Commission.

On September 2d District representatives met with Federal Forest Service officials at Echo Summit and selected a site suitable for the location of the maintenance station buildings. The site obtained is located on the north side of the road about one-fourth mile east of the actual summit. The highway at this point was completed in July, 1940.

The buildings being constructed are surrounded by towering pine trees which screen the development from roadway view. Looking eastward from the site and a thousand feet below is glimpsed the southern end of famous Lake Tahoe and Lake Valley.

FOREST OFFICIALS COOPERATE

The utmost cooperation of U. S. Forest Service officials was given in granting immediate permission to start construction operations on the ground.

On September 3d clearing opera-

Bunkhouse foundation forms in place, Sept. 18

General view, with truck shed forms in background, Sept. 19

Pouring concrete on bunkhouse foundations, Sept. 23

Finishing floor of truck shed on Sept. 26

tions were started. While the site is relatively level, it was necessary to remove a heavy stand of pine and fir timber.

The first construction materials were delivered to the job on September 5th. Cement was on the job site on September 8th and thereafter materials arrived daily. A crew of eight carpenters and 12 laborers started work on September 10th. On the fifth working day thereafter the first concrete was poured, the foundation of the truck shed being the first unit started.

For the first two weeks of work on the buildings, operations, while going full speed, were slightly handicapped by having to work around the tree falling, burning, and stumping crews.

FOUR BUILDINGS UNDER WAY

The maintenance station is to consist of four buildings—a bunkhouse, a truck shed, a boiler house, and a gasoline and oil storage house.

The bunkhouse is to be a two-story frame building with redwood rustic siding capable of housing about 30 men at the peak period. The lower floor will have a kitchen, cook's quarters, dining room, foreman's office and radio room, drying room, wash room, and lobby. The upstairs will be divided into two dormitory rooms.

The truck shed is to be 40 feet deep by 107 feet long. At one end of the truck shed and completely walled off from the garage portion will be a well-stocked and equipped shop for the repair and service of equipment.

STEAM PLANT NECESSARY

The boiler house will contain the steam plant and the power generator. Electricity is not available at Echo Summit at this time and a temporary power plant is to be used until such time as electric lines are extended to the summit.

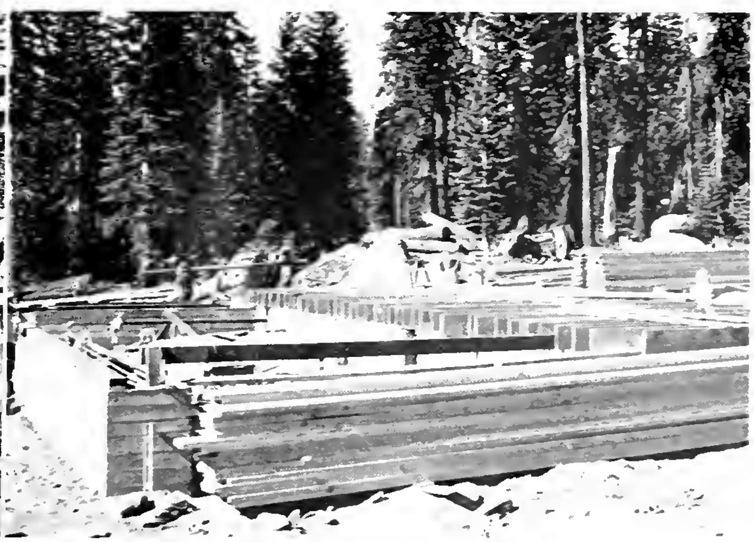
A standard 16 by 18 foot gasoline and oil house with an electric gasoline pump completes the buildings at this station. Underground storage for approximately 4,000 gallons of gasoline is being provided.

In accordance with a ruling of the Forest Service all buildings are being set back 200 feet from the center line of the highway except in the case of the gasoline and oil house. Permission was granted to place this building only 100 feet from the center line of the highway. There is a clear distance of 50 feet between all buildings for fire prevention.

DIGGING LARGE WELL

Other appurtenances at this station include a buried 8,000-gallon fuel oil tank, a 1,500-gallon metal septic tank, an elevated water reserve storage tank, and a lined well. This latter item is being dug by a local well-drilling contractor under an emergency contract. The feature of this well is to be its underground drifts running laterally at the foot of the opening to provide additional

Truck shed framing being erected, Sept. 30



Floor joists on bunkhouse foundation, Sept. 30

storage for emergency use. These laterals are to be two in number and each is to be six feet high, four feet wide, and five feet long. A pressure system is to be installed in a pit at the top of the well at about ground level.

About a foot of topsoil and pine needles has been cleared off the site, disclosing a good grade of granite for use as subgrade. Local granite, road-mixed with liquid asphalt SC-3 sufficient to provide a three-inch compacted thickness, has been stockpiled for use in surfacing the yard and driveways.

FORTY MEN AT WORK

As this magazine goes to press all of the concrete foundations, footings, and floor slabs have been poured. Framing of the bunk house and truck shed is under way, the well is being dug, steam, sewer, and water lines are being laid, and the yard area is being graded. All clearing and stumping has been completed and the surfacing is ready to be placed.

On the last day of September more than 40 men were actively engaged in construction on the site. Materials were nearly all on the job but some few delays have been encountered in obtaining the necessary materials and supplies.

The original force of eight carpenters and 12 laborers was increased to 11 carpenters and 16 laborers on September 29th in order to proceed with actual fabrication of the various buildings with the utmost speed. The entire project with the exception of the well digging is being handled by the State on a day labor basis in order that the work could be started at the earliest possible moment.

All snow removal equipment has been ordered and a part of it is on hand at the present time. No delays on the balance of the equipment are anticipated.

Rushing Work on Highway Across Isthmus of Panama

Under the blazing tropical sun by day and under electric lights at night, 1,000 men are working on defense-spurred schedules to complete by next spring the first highway across the Isthmus of Panama at the Canal Zone.

The 50-mile highway will connect Colon on the Atlantic end of the Panama Canal with Panama on the Pacific end, and serve about 200,000 people in the Isthmian area. It will be the first transisthmian road since the days of the gold trail of the Seventeenth Century.

Traffic on State-Owned Toll Bridges Again Shows Increases in September

THROUGHOUT the month of September there was a continuation of the large volume of traffic which for some time has been characteristic of the State-owned toll bridges.

On the San Francisco-Oakland Bay Bridge, the daily average was 57,131 vehicles, representing an increase of 2 per cent over September, 1940.

Carquinez Bridge, with an average of 14,982 vehicles per day, showed a gain of 55 per cent over the same month of 1940. The heaviest single day's traffic occurred on September 1, when 24,697 vehicles crossed the bridge, establishing a new high record.

Antioch Bridge broke all previous records with an average of 1,018 vehicles per day.

September 16th marked the first anniversary of the day on which the State of California acquired the Carquinez and Antioch bridges. The total traffic for the first 12 months under State operation was 4,106,689 vehicles on the Carquinez Bridge, and 244,041 on the Antioch Bridge.

The vehicular traffic for September on the San Francisco-Oakland Bay Bridge and the Carquinez and Antioch bridges is tabulated below:

	San Francisco-Oakland Bay Bridge	Carquinez Bridge	Antioch Bridge
Passenger autos and auto trailers	1,541,522	407,511	23,522
Motorcycles and tricars	5,254	1,524	66
Buses	43,950	6,033	189
Trucks and truck trailers	85,002	34,138	6,730
Others	38,214	242	45
Total vehicles	1,713,942	449,448	30,552

New Divided Highway Units on U. S. 99

(Continued from page 16)

from each other at the northerly end.

The westerly bridge over Bear Creek is 250 feet long with four center spans each 46 feet 8 inches long and two end spans of 31 feet 8 inches length, all supported on concrete piles.

The easterly bridge is 230 feet 7¼ inches long, with four center spans each 43 feet long and two end spans of 29 feet 2½ inches length. Each structure has a 26-foot clear roadway with a 5-foot sidewalk on the outside. Concrete railing is used throughout.

The bridge over Black Rascal Creek is a skew concrete structure 94 feet in length and consists of four equal spans, all supported on concrete piles. It has a 27-foot roadway width.

The concrete bridge over the overflow is normal to the roadway 52 feet long with two equal spans on concrete piling. The roadway is 27 feet in width.

The approximate cost was $177,400.

The next project in order is the divided highway now under construction, south of Modesto between Keyes and Hatch Crossing, which will doubtless be completed by the time this article goes to press.

This project, initiated primarily to afford better facilities for over 10,000 vehicles now using this road, begins at the southerly end of the three-lane pavement at Hatch Crossing about 1.5 miles south of the south city limits of Modesto and extends southerly 5.51 miles to Keyes.

It consists in the main of a 23-foot portland cement concrete roadway with a 31-foot separation between the old and new pavement, except through Ceres where the pavement averages 50 feet in width and consists of plant-mix surfacing over the old pavement and new concrete base.

The total length of divided highway excluding the widened portion through Ceres and the transitions at each end is 4.64 miles.

The allotment for this job is about $231,000.

The final project was handled in three contracts, the first for grading begun in February, 1940, and completed in September, 1940, consisting in general of constructing a graded roadway; placing imported subgrade material and applying road-mix surface over the full width. A reinforced concrete slab bridge was constructed over South Dutchman Creek consisting of three 16-foot spans and two 6-foot cantilever spans supported on concrete pile bents.

The second contract was for constructing a bridge over Chowchilla River just south of the northerly boundary of Madera County. This bridge is of reinforced concrete 132 feet long with a clear roadbed of 27 feet resting on concrete piles.

Under the contract, now under way, approved August 23, 1941, the work to be done consists in general of constructing a portland cement concrete pavement upon the previously constructed grade finished under contract last year. This pavement will be 23 feet wide; crusher run base borders 2 feet wide and 6 inches thick are provided for each side and 2 inches of plant mix extending for the full 8 feet of shoulder on the outside and 5-foot shoulder on the inside.

The original grading proved its worth last winter by making it possible to keep traffic moving by diverting it onto the new grade when during a period of high water the old road was closed, while the new grade was above water.

This divided highway, in use in these two counties, has proved so beneficial in relieving the traffic congestion that it is hoped funds will be made available to not only complete the work in Stanislaus and Merced Counties, but also through San Joaquin County where traffic conditions are fully as bad.

Traveling salesmen drive their automobiles an average of 18,791 miles per year, according to a recent survey. It is estimated that physicians drive their cars 12,932 miles annually; attorneys, 12,898 miles; insurance and real estate salesmen, 12,618 miles; unclassified salesmen, 12,303 miles; workers, 7,657 miles; farmers, 5,750 miles; all persons employed in other occupations, 8,650 miles.

It was their first day in military camp, and the two colored recruits were sitting in the kitchen, more or less industriously removing the skins from potatoes.

"How come," demanded the first, "how come dat officer keeps callin' us K. P.—K. P.?"

"Hush yo' mouf, Ignorance," advised the second. "Dat am de abbreviation for Keep Peelin'—Keep Peelin'."

Old narrow bridge across Dos Pueblos Creek was replaced by modern structure

State Jails Boys Who Move Road Signs

The mutilation, destruction or removal of official State Highway Signs is a violation of law punishable by arrest, and imprisonment of the guilty person upon conviction in court.

The cost of material and maintenance of the signs of the State Highway System approximated $160,000 last year.

A recent instance was the case of two boys who were returning from a holiday trip in the mountains and ran out of gas at a highway intersection. A third boy, the driver of the car, caught a ride to the nearest service station for gas, and while he was gone the other two removed and put in their car a reflectorized sign reading "DETOUR" and moved another sign reading "BRIDGE OUT 8 MILES AHEAD" to another location in the intersection where it gave a false message to traffic.

Later the boys again ran out of gas and abandoned the car for the balance of the night. The Police Department, found the "DETOUR" sign in the car, hunted up the boys and found out from them what had happened. The State highway district office was notified, the District Traffic Engineer made an investigation and signed a complaint.

The complaint was filed with a Justice of the Peace and a warrant for the arrest of the boys was issued. The older boy was sentenced to 10 days in jail, but the sentence was suspended on the condition that he replace the signs in their original position (which had already been done by highway employees) and also repair all damaged signs between the intersecting routes, for a total distance of approximately 44 miles.

The younger boy whose case was referred to the Juvenile Court, was apparently only reprimanded by the judge.

Coast Road West of Santa Barbara Under Reconstruction

(Continued from page 10)

Varas Creek will cost approximately $260,000. The Dos Pueblos Creek bridge cost was $21,168.

The contract between Orella and one mile west of Canada del Refugio will cost about $199,000, including the bridge across Refugio Creek. It is expected that all work on both contracts will be completed about the first week in November.

The firm of Basich Brothers of Torrance are the contractors on both of the road contracts and the Dos Pueblos Creek bridge was built by Carl Hallin. J. C. Adams has been Resident Engineer for the State on road construction and E. C. Bissell was Resident Engineer for the Bridge Department.

Three Way Channelization Project Completed on U. S. 101, Near Redding

By F. N. DRINKHALL, Resident Engineer

RECENT completion of a section of Route 3 through Redding, between the Southern Pacific Subway and Hill Street, on the Pacific Highway, U. S. 99, was of special interest as it was the first experience with channelization at an important intersection in that district.

This particular intersection will assume still greater importance at a future date when it will become a part of Route 20 between Redding and Lassen Volcanic National Park and connect with a proposed new bridge across the Sacramento River at the foot of Cypress Street.

The project, in general, converted the existing two-lane, paved road into a four-lane divided highway improving grade and line in the process. Driving lanes are portland cement concrete pavement 11 feet in width, with passing lanes of plant-mix surfacing 12 feet in width over six inches of crusher-run base.

Opposing lanes of traffic were divided by raised bars with double traffic stripes at the southerly end of the project and by irregular shaped division strip areas, partially bounded by concrete curbs through the more congested section.

3-WAY CHANNELIZATION

The most important intersection was given a three way channelization treatment, complete with acceleration and deceleration lanes, that has since proved adequate in controlling and directing traffic and reducing traffic hazards. Three flashing beacons, numerous ruby reflectors and painted recessed division strip curb faces were installed to further aid in safeguarding traffic.

Due to the close proximity of buildings and side streets, gravity and reinforced concrete walls were placed to obtain the required roadway width in cuts without running into exorbitant right of way costs and other complications.

The project was started on August 12, 1940.

Due to the lateness of the season the contractor conducted his grading operations on a 24-hour basis; the first rains came the day he completed his grading, October 23d. During the latter part of November and first half of December one lane of portland cement concrete pavement and the lower course of crusher run base was placed and served to partially carry traffic through the winter months.

MOISTURE TESTS NECESSARY

Throughout the Winter and Spring progress had to contend with adverse weather conditions with intermittent dry spells that were seldom long enough to dry out the grade. This was a source of constant concern to the Resident Engineer, causing frequent discussion as to the permissible moisture condition of subgrade and crusher-run base to permit placement of plant-mix surfacing.

Local U. S. Weather Bureau predictions plus a maximum permissible moisture in the crusher-run base of 5 per cent and in shoulder material of 10 per cent, controlled placement of plant-mixed surface. These moisture percentages were the optimum moisture contents as shown by laboratory tests on the materials involved. Over eighty field moisture tests were taken and the results used to definitely settle the question of plant-mixed placement.

Items of interest in the construction methods employed were as follows: The special provisions called for automatic batching of concrete aggregates. The contractor erected an automatic concrete aggregate batching plant close to a commercial crushing plant, using an existing stockpile as the approach road to the hoppers.

Portland cement concrete pavement float finishing was done with a mechanical float which did an excellent job with an experienced operator in charge.

Plant-mixed surfacing placement and finishing was done with a bituminous paver.

BLENDER SCREEDS EXTENDED

In order to conceal the longitudinal joint line that is sometimes visible after laying two adjoining strips with these machines, extensions were placed on the blender screeds which increased the spread width to 14 feet. This placed the joint in the center of the highway and under the raised bars. It was found that by compacting a half foot width of the first laid strip at the same time as the adjoining strip, the longitudinal joint is almost entirely eliminated.

As frequently happens on construction jobs within city limits unexpected items ran high in cost. During grading operations an old sewer tunnel was uncovered, large enough to walk through. This had to be excavated and backfilled. A cut face slip out above one of the retaining walls necessitated installing perforated drains back of the wall and slope paving above the wall to retain the backfilled cut face on a 1-1 slope.

COSTLY RECORD RAINS

The long record high rainy season ran up the maintenance of traveled way costs, and increased the item of crusher-run base due to loss of fouled material that had to be replaced.

Excavation of unsuitable material, particularly at the south end of the project, was a costly item. Backfill had to be placed with selected rock and drains provided because of a high water table that turned the natural material into an unstable mass. Altogether the long list of

(Continued on page 24)

Views of channelization project recently completed on U. S. 99 near Redding that converted the existing 2-lane road into a 4-lane divided highway. At the 3-way intersection with Route 20 and the highway to Volcanic National Park, opposing traffic is separated by irregular shaped division strip areas partially bounded by concrete curbs.

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Bids and Awards for the Month of September, 1941

FRESNO COUNTY—Widening a bridge across Herndon Canal 1.3 miles north of Fresno. District VI, Route 125, Section C. F. Fredenburg, South San Francisco, $24,983. Contract awarded to Trewhitt Shields and Fisher, Fresno, $19,342.

FRESNO COUNTY—Between 0.2 mile west of Parkfield Junction and 1.3 miles east of Parkfield Junction, about 1.2 miles to be graded. District VI, Route 10, Sections B,C. Rhoades Bros., Los Angeles, $64,563; Claude C. Wood and W. C. Watson, Lodi, $68,445; M. J. Ruddy, Modesto, $78,246; Piombo Bros. Co., San Francisco, $91,229; Stewart & Nuss, Inc., Fresno, $132,648. Contract awarded to Harms Bros., Sacramento, $62,193.

HUMBOLDT AND SISKIYOU COUNTIES—Two bridges across Eel River, one at Robinson Ferry and one at North Scotia to be removed and salvaged and a bridge across Salmon River at Somes Bar to be constructed with salvaged steel. District I, Routes 1 & 46, Sections E & A. A. Soda & Son, Oakland, $83,664; Kiss Crane Service, Berkeley, $86,620; Ralph A. Bell, Eureka, $173,315; Harry J. Oser, San Francisco, $193,854. Contract awarded to C. W. Caletti & Co., San Rafael, $74,259.

KERN COUNTY—Across Buena Vista Slough about 9 miles northeast of McKittrick, a timber bridge to be constructed. District VI, Route 58, Section J. George von Kleinsmid, Bakersfield, $25,780; Kiss Crane Service, Berkeley, $27,928; F. Fredenburg, South San Francisco, $29,981. Contract awarded to Rexroth and Rexroth, Bakersfield, $22,997.

KERN COUNTY—Between Southern Pacific Railroad and Levee Canal, about 0.8 mile to be graded and a cement treated base to be constructed and surfaced with asphalt concrete, and a reinforced concrete culvert to be extended. District VI, Route 142, Section Bakersfield,A. Contract awarded to Griffith Co., Los Angeles, $69,969.

LOS ANGELES COUNTY—Construct system of traffic signals on Redondo Wilmington Blvd. between Pennsylvania and Walnut Avenues. District VII, Route 60, Section D. Econolite Corp., Los Angeles, $11,500; Martin J. McCarthy, Los Angeles, $12,543. Contract awarded to Newbery Electric Corp., Los Angeles, $10,564.

MENDOCINO COUNTY—Between 6.1 miles and 5.3 miles south of Ukiah, about 0.2 mile to be graded and surfaced with plant mixed surfacing. District I, Route 1, Section B. Lee J. Immel, Berkeley, $33,311; Maeco Construction Co., Clearwater, $48,095. Contract awarded to Harold Smith, St. Helena, $26,126.

MENDOCINO COUNTY—Between Hopland and Crawford Ranch, about 6.3 miles to be graded. District I, Route 1, Section B. Claude C. Wood, W. C. Watson and L. D. Tonn, Lodi, $300,725; N. M. Ball Sons, Berkeley, $328,645; Parish Bros., Sacramento, $333,731. Contract awarded to Maeco Construction Co., Clearwater, $251,217.

PLACER COUNTY—Between Roseville and 0.6 mile east, about 0.7 mile to be graded and surfaced with plant mixed surfacing. District III, Route 17, Section Roseville,A. Parish Bros., Sacramento, $28,140; A. Teichert & Son, Inc., Sacramento, $33,649. Contract awarded to Poulos & McEwen, Sacramento, $26,728.

RIVERSIDE COUNTY—Between Orange County Line and Corona, a nonskid surface treatment. District VIII, Route 43, Section A. Contract awarded to Oswald Bros., Los Angeles, $5,870.

SAN LUIS OBISPO COUNTY—At Cholame Creek about 22 miles east of Paso Robles, a reinforced concrete girder bridge to be constructed, and about 0.4 mile of roadway to be graded and surfaced with road mixed surfacing on crusher run base. District V, Route 33, Section B. Trewhitt Shields and Fisher, Fresno, $63,491. Contract awarded to Dan Caputo, San Jose, $58,763.

VENTURA COUNTY—At Pole Creek, bridge to be raised and about 0.2 mile of grading and paving with asphalt concrete. District VII, Route 79, Section Filmore,C. J. S. Metzger & Son, Los Angeles, $14,002; A. S. Vinnell Co., Alhambra, $16,569. Contract awarded to J. E. Haddock, Ltd., Pasadena, $13,865.

YOLO COUNTY—Between Cache Creek Bridge and 0.4 mile north, about 0.4 mile to be graded and surfaced with plant mixed surfacing on gravel base. District III, Route 87, Section A. Hemstreet and Bell, Marysville, $23,425; Parish Bros., Sacramento, $23,801; Poulos & McEwen, Sacramento, $26,218; A. Teichert & Son, Inc., Sacramento, $26,249. Contract awarded to Louis Biasotti & Son, Stockton, $22,791.45.

An Appreciation

Beverly Hills, California

My dear Sirs:

This is just a note I wish to write in commendation of the men whom you have working for you. I noticed in the newspaper that printed an account of the accident occurring on the road between Igo's and Camp Angelus on August 25th that your men were not mentioned and being one who would like to see "credit given where it is due" I felt it my duty as a rather heavy taxpayer to tell you of their wonderful work. I know because I was the one that called for help for the injured people.

The ranger at Camp Angelus was not there so I went to the house of E. G. Boyd who works for you. He immediately got up at 1.30 in the morning and went with another woman friend and myself to investigate. He came back up the mountain and got Joe Holt (maintenance foreman) who came with first aid, stretchers, etc.,—and maybe you think they didn't work. It took two hours for them to get the woman who was injured from the bottom of the canyon to the top. In the meantime, the CCC boys came and helped but I just can't imagine what would have happened to those injured people at the bottom of the canyon had it not been for Mr. Boyd and Mr. Holt.

I just want to say that I am happy there are such people and they gave their time and energy so very unsparingly.

Thank you for a grand highway maintenance organization.

Sincerely,

Mrs. Hartle Tallman.

Channelization Project Completed at Redding

(Continued from page 22)

unexpected items accounted for approximately 7 per cent of the final cost of the project.

Original plans called for the dividing strip areas to be filled in to top of curbs. During the life of the contract it was decided to leave these areas low to permit a future filling in with loam as part of a proposed general landscaping project that will make this southern entrance to Redding ornamental, as well as useful.

Final total cost of the project, a Federal Aid job, amounted to $120,082. Length 1.10 miles.

Fredericksen & Westbrook were the contractors, with Jerry Bing as their Superintendent for the greater part of the contract time. The writer was Resident Engineer for District II of the Division of Highways.

94 Grade Curves Abolished

(Continued from page 6)

Following the formal opening several hundred cars caravaned over the new grade into Warthan Canyon for a picnic and entertainment by the Mustang Mountain Rangers Quartet.

On this State Highway Sign Route 198 between Coalinga and San Lucas the Division of Highways has inaugurated 11 major construction projects during the past 20 years. Six of these projects were in Monterey County and five in Fresno County, and the total cost of these 11 improvements was about $872,700.

Laws Effective Jan. 1, 1942 Covering Weights of Vehicles

(Continued from page 17)

as computed by the formula W=850 (L+40) but this gross must not exceed 68,000 lbs. 850 (L+40) equals 68,000 lbs. when L=40 so all vehicle combinations whose wheel base is between 40 and 45 feet are permitted a gross of 68,000 lbs. provided of course permissible axle loads and concentrations within 14 or 18 feet are not exceeded.

In a following issue of this magazine there will be shown by illustrations how the law applies to various types of commercial vehicles using California highways.

State of California

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Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

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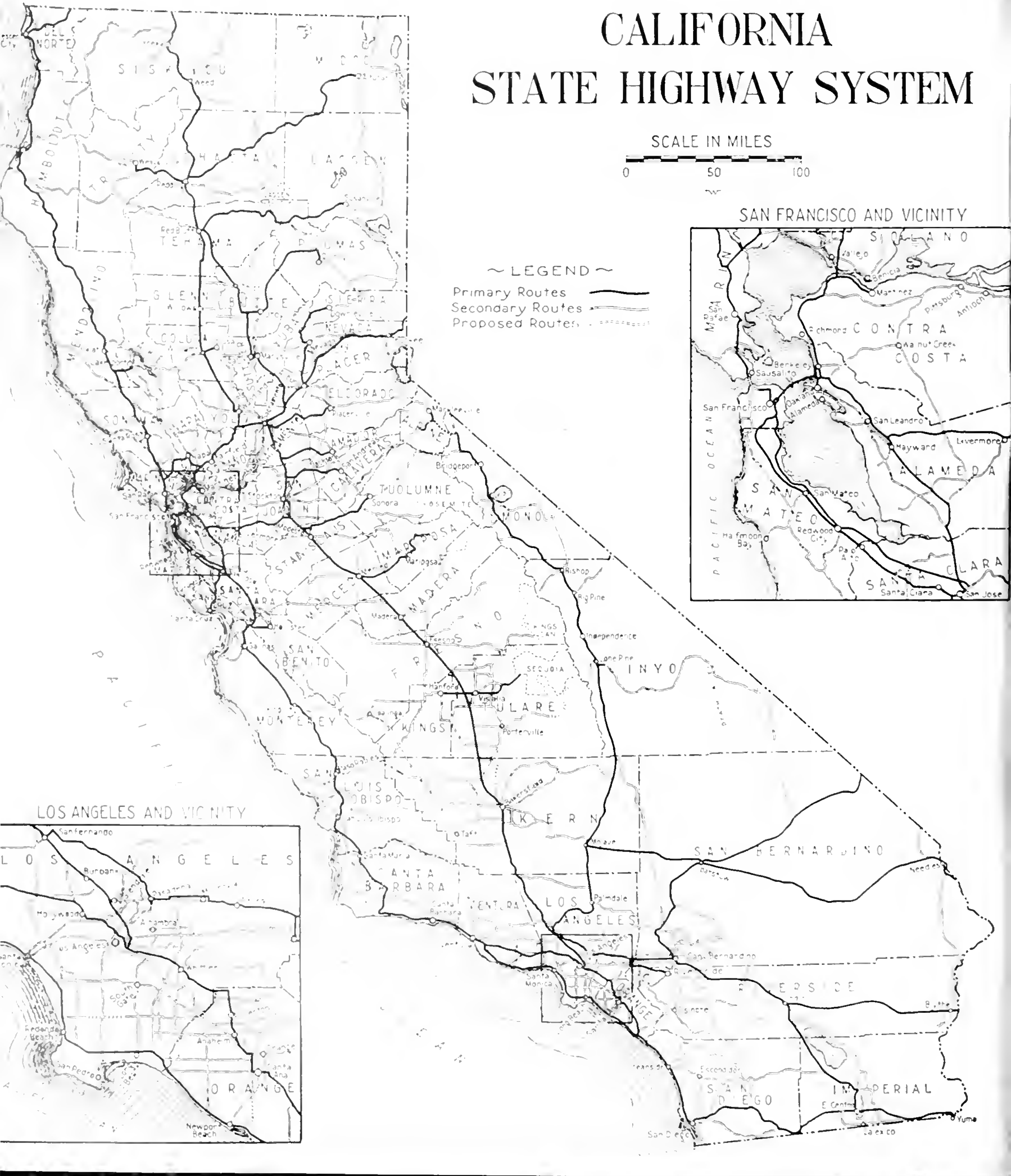
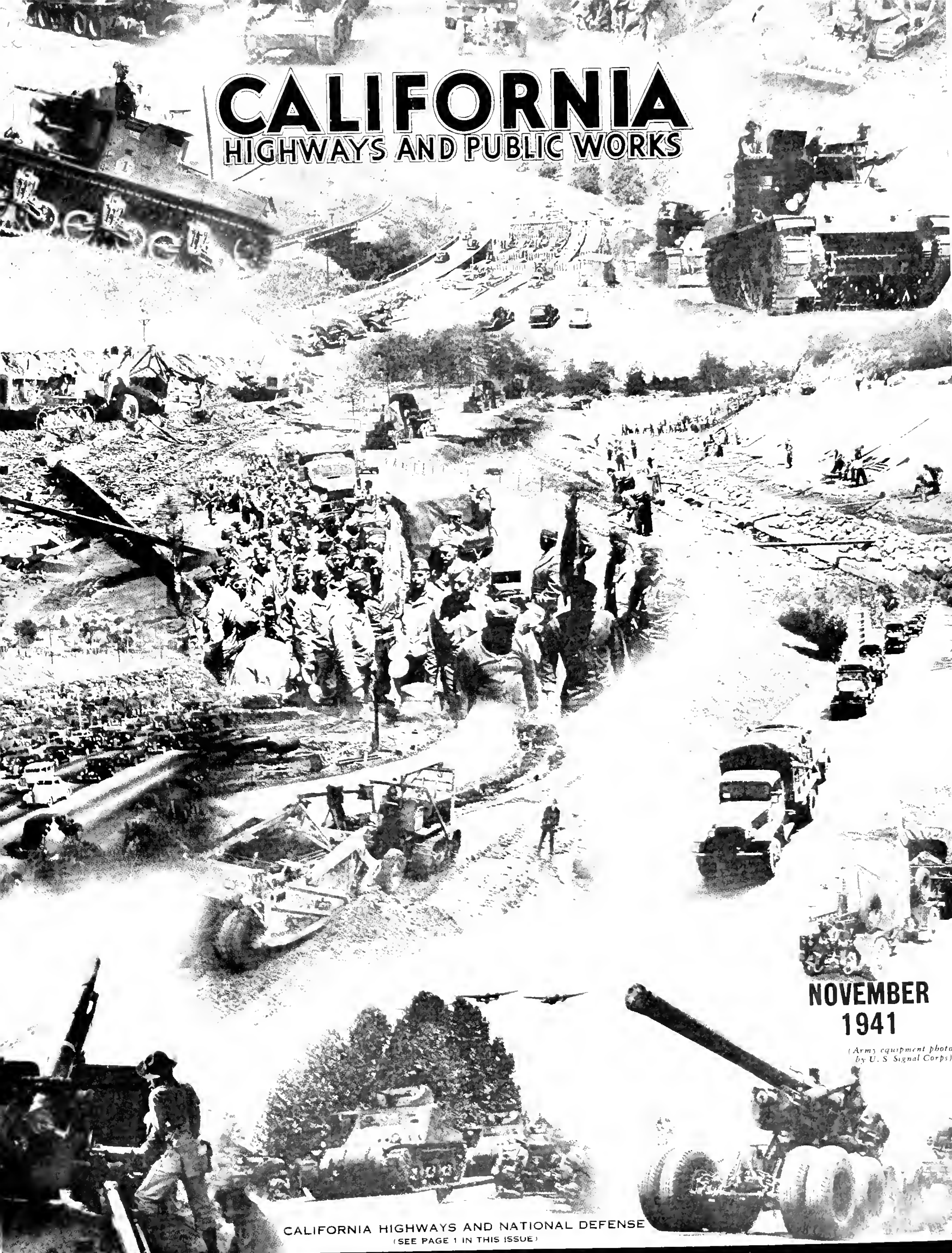


CALIFORNIA HIGHWAYS AND PUBLIC WORKS



NOVEMBER 1941

(Army equipment photos by U. S. Signal Corps)

CALIFORNIA HIGHWAYS AND NATIONAL DEFENSE

(SEE PAGE 1 IN THIS ISSUE)

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California

FRANK W. CLARK, Director — C. H. PURCELL, State Highway Engineer — J. W. HOWE, Editor — K. C. ADAMS, Associate Editor

Published for information of department members and citizens of California. Editors of newspapers and others are privileged to use matter contained herein Cuts will be gladly loaned upon request. Address communications to California Highways and Public Works, P. O. Box 1499, Sacramento, California

Vol. 19 — NOVEMBER, 1941 — No. 11

Table of Contents

National Defense Demands Compel Some Revisions and Postponements of Projects in State Highway Budget

By FRANK W. CLARK, Director of Public Works

NORMAL development of the California State Highway System must be curtailed in order to meet urgent demands of the Army and Navy for defense roads.

Revision of our highway budget for the 93d and 94th fiscal years is the only way in which the National defense requirements of the Federal Government can be met.

Major projects in the present biennial budget amounting to between four and five million dollars may have to be revised or deferred.

As this magazine goes to press the exact locations of these deferments and reductions are being determined by the California Highway Commission and the Department of Public Works. The specific details will be published in the December issue.

DEFENSE PROGRAM EFFECTS

In so far as possible, we seek to reduce the length of projects rather than eliminate them but it may be necessary to strike from the budget entirely certain contemplated improvements.

For the past six or eight months, we in the Department of Public Works have been increasingly aware of the impact of the National Defense Program on our activities. Most everyone is more or less familiar with the effect of the defense program on our private lives and businesses, but I do not believe that the average individual, or the motoring public in general, yet fully realizes just how serious the matter is from the highway standpoint.

In September, October and November of last year the California State Highway Commission in consultation with the Director of the Department of Public Works and engineers of the Division of Highways adopted our highway budget for the 93d and 94th fiscal years.

FRANK W. CLARK

This budget appropriated approximately $37,000,000 for major project construction on the California State Highway System. This figure included $7,600,000 of Federal aid funds that we estimated would be available for expenditure by the State on the Federal Aid System.

BUDGET BALANCE NEEDS

That $37,000,000 budget was the result of a great deal of work and most careful consideration on the part of both the State Highway Engineer and the Director of Public Works and the State Highway Commission.

In accordance with the wishes of the Governor, the commission sought to determine the projects most necessary from the standpoint of the greatest good for the entire State. It sought to balance the needs of the ordinary traveling public and the shipper of freight on the highways.

It concerned itself with heavily traveled urban and interurban routes and with lightly traveled secondary and recreational highways. It attempted to make its allocations with a view to the sound future development of the highway system. At the same time it tried to keep a reasonable balance of highway expenditures between the various geographical sections of the State.

In its deliberations the commission had before it the recommendations of each of the 11 district engineers covering what they considered to be the most necessary improvements in their districts. These recommendations had in turn been passed upon by the State Highway Engineer C. H. Purcell and his central office staff and by the director's office.

REPRESENTS SOUND PROGRAM

The budget released to the public in January of this year was the result. It represented a sound construction program for the next two years. It is a program that has been widely publicized and has received the approbation or disapproval, as the case may be, of a great many interested groups.

We are now confronted with a situation requiring that we seriously reconsider that program, not only from the standpoint of the necessity of some of the projects in the light of present-day circumstances, but, and more important, from the standpoint of the actual feasibility of their construction.

I hope that in the months ahead the public throughout California will understand what confronts the administration and the need for action on our part.

COSTS NOW HIGHER

There are a number of reasons for this condition. In the first place, it must be remembered that the engineers' estimates on which the budget allocations were based were prepared prior to the meetings of the Highway Commission last autumn. That means that the actual engineering figures on the estimated cost of construction of any particular project were compiled at least 12 months and in some cases 14 or 15 months ago.

Estimates prepared in our office indicate that current construction costs are approximately 20 per cent higher than they were a year ago and the possibilities are that this rise will continue. Higher wages for both skilled and unskilled labor are felt not only in the labor used on the work itself but in the increased cost of the materials.

More important still is the uncertainty of obtaining many materials and the difficulty many contractors experience in attempting to replace equipment, both tending to increase bid prices submitted for highway construction.

DEFENSE FACILITIES EXPANDED

Finally, California with its thousands of miles of coast line, temperate climate, and large aircraft industries is a concentration point for Army, Navy, and Marine camps, training stations, air fields and the like and the rapid expansion of these facilities has resulted in an unprecedented amount of construction activity in this area.

This increase in construction has tended to decrease the supply of available skilled labor and to decrease the field of available bidders which in turn has had a marked effect in raising the bid prices submitted.

The defense program, however, makes itself felt in the Department of Public Works in other ways than in increased construction costs. During the past several months, all construction agencies, public and private alike, have experienced increasingly great difficulty in obtaining certain critical materials.

At the time of the establishment of the Office of Production Management, certain engineers of the Division of Highways were assigned to the task of studying this problem and cooperating with the Federal Government in the matter of obtaining proper priority designations for the several classes of highway construction.

GOVERNOR CONTACTED WASHINGTON

Both Governor Olson and I have communicated directly with Washington on numerous occasions regarding this matter, and in August, the Governor sent to Washington as his personal representative on this matter Deputy Director of Finance John Welsh in an effort to aid the Division of Highways, Division of Architecture and other interested State agencies in obtaining the required priorities.

The most critical commodity from the standpoint of highway construction up to the present has been steel, for most of our structural steel in California is shipped from eastern mills and due to the scarcity of maritime shipping to the west coast, consignments for the past six or eight months have of necessity come by rail.

RAIL FACILITIES CONGESTED

There has been a tremendous increase in railroad business and the rail facilities of the country are badly congested, so much so in fact that shipments of structural steel to this area have been coming in very slowly. Thus, while we have, as an administrative matter succeeded in obtaining relatively high priorities for most of our highway jobs, those priorities alone have not been enough to assure the prompt arrival of the steel on the job and both the State and its contractors have been and still are experiencing difficulty in obtaining deliveries of steel.

THREE MONTHS DELAY

The North Sacramento Viaduct for instance, which is a vital defense link between Sacramento and the Army Air Depot at McClellan Field and Mather Field, is now several weeks behind schedule because of a lack of reinforcing bars, even though this project carries a priority rating of A-1-E, equal to that of the air depot itself.

To give other examples the Azusa Underpass, east of Los Angeles, was delayed approximately three months because the structural steel necessary for its completion was rolled by eastern mills and lay there that length of time in an eastern port awaiting shipment to the Pacific Coast.

Similar delays have been experienced in the construction of structures across Eureka Slough in Humboldt County and the south fork of Putah Creek on the Sacramento-San Francisco highway, and in the case of various grade separation structures on the Figueroa Street extension of the Arroyo Seco Parkway in Los Angeles.

In addition to these difficulties already encountered, we are now advised that a recent ruling of the Supply Priorities and Allocations Board will confine allocations of strategic materials to improvements to the established strategic highway network and access roads.

IMPROVEMENTS MUST WAIT

Should this be the case and such a ruling actually put into operation, the State's construction program will for all practical purposes be limited to defense projects, and our normal highway development will necessarily be limited to approximately 6,000 miles of State highways and to the established access roads. Stated differently, approximately 8,000 miles of State highways scattered throughout every county in California will have to let their improvements wait.

Our situation is further aggravated because of the access road problem. We have in California an enormous number of military, Navy, and Marine establishments. The program of access roads to these establishments includes approximately $40,000,000 in highway and bridge projects. Since a great majority of these projects are off the State highway system, their construction by State funds is impossible under State law.

Nevertheless, the California Division of Highways has so far expended about $1,200,000 of regularly allocated Federal aid and Feeder funds for surveys and preparations of plans for requested access roads. This work on the access road program has, of course, interfered with our normal operations. State highway personnel has had to be assigned to it at a time when because of the draft, the expansion of the Reserve Corps, and the high salaries offered by various industrial plants, it has been most difficult to keep an engineering organization intact.

SOME ROADS OVERBURDENED

However, our troubles and the troubles of the Californians interested in the highway system do not even end there. Defense activities in Califor-

Photo by U. S. Signal Corps

Two and a half ton army trucks hauling 155 millimeter guns through woods on a dirt access road

nia such as the construction of the large military cantonments at Fort Ord, Fort Roberts, Camp San Luis Obispo, and elsewhere have changed the character and volume of travel on State highways to an almost unbelievable extent.

Near Lompoc, for example, the Federal Government is now constructing a camp for an armored division. This cantonment will be served by our State Highway Routes 56 and 149, both of which have always been assumed to be secondary highways carrying a relatively small number of vehicles and a relatively light type of traffic.

Construction of facilities to house a full armored division and the subsequent establishment of that division on such a road places a greater burden on that road in a period of six months than it was designed to carry in six years.

This same condition exists in other localities in the State where highways designed for relatively light rural and farm-to-market traffic have suddenly become main arteries over which thousands of tons of construction materials, foodstuffs and implements of war are moved every month.

MAINTENANCE PROBLEM COMPLICATED

The extent to which this particular phase of the problem will affect our maintenance work no one can tell at this time. Should we have an unusually heavy winter it is conceivable that the demands on our maintenance forces might become so great that substantial sums would have to be diverted from construction in order to even keep these roads open, as obviously there is no time to complete reconstruction to higher standards before the winter rains set in.

In this connection, a large proportion of the new traffic burden being Federal in nature does not support highway improvement through contribution to the gas tax and motor vehicle fees. This necessarily shifts a great responsibility to our supporting State traffic.

It must therefore be realized that in the last analysis we do not have absolute discretion as to the expenditure of our funds. Section 18 of the Federal Highway Act clearly states that the Federal Government may limit the use of all Federal aid funds to projects in the strategic network.

When it is considered that these Federal funds have been budgeted for this biennium, and that there has been budgeted an equal amount of State funds to match them, it is not difficult to visualize the result should the Federal Government require the expenditure of all Federal aid funds on certain strategic highways.

We would not only be required to change our budget to the extent of the Federal aid funds but would also be required to shift an equal amount of State money, or lose the Federal funds altogether.

FEDERAL AID LOSS POSSIBLE

This condition has not yet arisen, and we are attempting to forestall it to the best of our ability by budgeting our Federal moneys as far as possible on strategic highways, but it is a possibility that does exist and one that should be borne in mind by all of us.

Obviously, some adjustment of our existing highway budget will be necessary. How great an adjustment can not be predicted at this time because many varying factors such as the fact that we are realizing an

(Continued on page 13)

Designing Foundation Courses for Highway Pavements and Surfaces

The following article is a paper prepared and read by Mr. Fred J. Grumm before the Public Works Officers Department of the League of California Cities in Sacramento, October 15, concerning adequate subgrades for highways.

By FRED J. GRUMM, Engineer of Surveys and Plans

IT SEEMS almost unnecessary to begin this discussion with the obvious truism that the integrity and serviceability of any structure is dependent on its foundation. I realize fully such a statement contains nothing new or startling and that all of you subscribe to its inherent truth. Nevertheless, few truths have been so universally acknowledged in theory and so frequently ignored in practice by road or highway engineers, especially with respect to the foundations of their pavements and surfacings.

The reasons underlying this apparent disregard of one of the accepted and fundamental tenets of our engineering faith are not so easily stated. Many factors are involved ranging from economic considerations to blind optimism and ignorance of the really complex and infinitely variable material which we so casually designate as plain earth or "dirt."

KNOWLEDGE RECENTLY GAINED

It is rather astonishing to record the fact that a major part of our present extensive and specialized knowledge of "soil science," from the standpoint of its peculiar characteristics as an engineering material, has been acquired during the last 10 years. Strange, is it not, that man's oldest and most commonly utilized building material should have retained so much of its mystery for so many years.

It is not inferred by the above, that we have stripped Mother Nature of all her secrets, for there are many acute problems still crying for a solution. I do believe, however, that we are now in a position to utilize the recently gained knowledge of the soil technician to avoid those obvious pitfalls which produce results that are too frequently evident to the discerning eye as they are reflected in the present condition and service record of our streets and highways.

It is rarely practical, or, at least, economically feasible, to found our streets and highways upon bedrock, else the problem would be infinitely simplified. On the contrary, due to the vagaries of Mother Nature, the engineer is usually faced with the necessity of providing some means or method of spreading imposed concentrated loads over a sufficiently large area so that the resulting unit pressures applied to the underlying subgrade or subsoils are reduced to a value within the supporting capabilities of the material.

STABILIZATION TEST PROJECTS

The required result may be obtained in many ways. For instance, the pavement design itself may be of a type having considerable structural or "beam" strength, thus reducing the unit stresses transmitted to the subgrade to the required limiting values. The native supporting material, in such cases, must be of a type not susceptible to large volume change by the addition or subtraction of water, such as is characteristic of heavy clays or adobes which also have very low supporting values, when wet.

On the other hand, if a flexible pavement or surfacing is the determined design, the supporting subgrade will be subjected to much higher unit stresses under maximum legal wheel loads, inasmuch as pavements or surfacings of this type have no beam strength and show little, if any, greater load spreading characteristics than an equal thickness of well graded crushed rock or gravel. In such cases, good design will provide a "ballast" or base course of sufficient thickness and of high enough bearing value to withstand the high unit stresses to which it will be subjected. Native materials of a granular nature are often available within economical haul limits, having satisfactory quality for use as ballast courses in such cases.

It is, however, well to emphasize the importance of careful and thorough sampling and testing of such sources prior to their use to insure the availability of a sufficient quantity and quality for the intended work. Sedimentary deposits of such material in this State are seldom uniform and often contain deleterious deposits of clay which are difficult to detect by eye especially under the rapid methods of operation of modern construction equipment.

So-called "stabilization" of unsatisfactory native soils is sometimes economically justified, the most common stabilizing agents being Portland cement, bituminous materials or chemical admixtures. The State Division of Highways has constructed several test projects utilizing the first named of these admixtures and two or three using bituminous products. It is still too early in their service life to offer definite conclusions, but the well constructed soil-cement jobs show considerable promise, inasmuch as they bind together and develop considerable base strength. We have not attempted stabilization with chemical admixtures, as this method is more costly and of more doubtful utility as compared to the others at the present time.

A final method of improving the quality of an inferior soil, which we

Officials checking weight of large truck and trailer equipment on State Highway. Note portable scales in front of wheels

have used to advantage several times, is by the addition of a predetermined quantity of clean beach sand intimately mixed into the top 12 or 18 inches of a heavy and completely unsatisfactory clay loam. This method is rather costly due to the large percentage of sand usually required for best results, and the considerable processing involved, but is sometimes economically justified if the sand is easily and cheaply available.

Now that we have discussed the basic problem and some of the general and most common methods of solution, let us particularly examine into the necessity of foundation courses. When are they required? What should be their thickness and quality under the infinite variations of soil, climate and traffic conditions encountered in practical road and street construction?

First, let me say that in my opinion the present-day engineer who attempts to design a modern street or highway without a thorough and scientific study of the soils and materials involved is no longer worthy of his profession.

Under the best of conditions and in possession of all the facts which can be accumulated, the engineer seeking to design an economic, long lasting and thoroughly satisfactory road or street has a difficult enough task, without further complicating the problem through lack of information.

TRAINED PERSONNEL IMPERATIVE

Therefore, the first order of business is to determine what are the physical characteristics and the limits of the soil material of which, and upon which, we intend to build our facility. This is no job for an untrained man. Misinformation is often more dangerous than no information. Soil sampling procedure, as well as the actual test determinations demand trained and intelligent personnel, if we are to place full reliance upon the results.

There are several well developed methods of soil classification. In the California Division of Highways our laboratory has developed and perfected a test procedure which is as simple as any, and has the further advantage to commend it in that it does furnish some indication of the stability or bearing power as a soil both in the ideal state of optimum moisture and compaction as well as in the most unfavorable condition to which it may degrade by the accumulation of excess moisture.

The test consists essentially of penetrating a sample of the soil material, which has been previously compacted at its optimum moisture content under a load of 2,000 pounds per square inch, with a piston at a constant rate and noting the loads developed at certain specified penetrations. The specimen is then reconsolidated and soaked for a period of four days, to allow it take up as much moisture as it will.

The sample is confined in the mold during the soaking period by a porous disc and a 10-pound weight which represents the surcharge of the pavement. After soaking, the sample is again penetrated by the piston in the testing machine, and the loads again noted. The bearing value is expressed as a percentage of a standard granular sample of crushed well graded ideal material the loads and penetrations of which are considered as 100 per cent. The penetrations at which the loads are observed are in increments of 0.1 of an inch.

Another important characteristic of the material is observed during the soaking test. Early studies of soil expansion by our Materials and Research Laboratory indicated that each particular type of soil material had a state of equilibrium with respect to density and moisture content for each condition of confinement.

EXPANSION TEST DESCRIBED

It was found that the moisture capacity of a soil varied inversely as the superimposed load. Since the expansion of a foundation material which may be expected to occur under a gradual accumulation of moisture is of concern to us, the expansion test is performed by measuring the height of the sample, prior to soaking, and again measuring it after the four-day soaking period under the superimposed load representing the pavement or surfacing. The increase in height is recorded in terms of the original height and the percentage of swell computed.

Experience has demonstrated that a soil which shows "bearing values," as defined above, of under 10 per cent in the compacted and soaked state, and having high expansion, as measured by the swell test, is an unsatisfactory material to use under any type of pavement.

During the last 40 years numerous rules and formulae have been advanced for relating the wheel load unit pressures exerted on the surface of a pavement or surfacing to corresponding unit pressures on the subgrade. Despite the continuous and intensive study given to this problem, no rule or formula has yet been advanced which will yield a rational solution under the infinitely variable conditions and materials encountered in nature.

Hence, the "bearing value" test developed in this State does not yield a mathematical or formalized solution. It does give us a practical tool to evaluate the character of the soils encountered and through close observation and correlation over a period of years, it has permitted us to establish certain fairly accurate limiting conditions for soils and traffic loads, and for paving and surfacing types.

Before proceeding further with the enumeration of what these limiting conditions are, an explanation of another important tool which the Design Department of the Division of Highways has recently developed to evaluate another very important phase of design problems would be of interest.

As with any other strictly utilitarian structure we are very intimately concerned with the loads which our pavement must support, not only from the standpoint of the maximum weight, but also with respect to the probable total number.

Because the failure of a road surface results in nothing more serious than discomfort and possibly inconvenience to the users thereof, it is the established custom, for economic reasons, to design the road surface with a much lower factor of safety than is usual in structures where life and limb are at stake. As a consequence, the principles of fatigue enter into the problem to a much greater extent than is the case with most structures. Hence, not only the magnitude of loads are involved, but also the probable repetitions thereof, especially those which may stress the pavement up to 50 per cent or more of its ultimate strength.

FATIGUE FACTOR INVOLVED

It has long been known that the destructive effects of repetitive wheel loads of increasing weight is much more severe than the flat increase in the load would indicate. In the case of rigid pavements this "fatigue effect" has been definitely established and evaluated, but in the case of flexible types its effects have not been determined with the same certainty. However, by careful study of service records and their correlation with traffic and load data accumulated by our Planning Survey, it is plainly evident this same fatigue factor is just as important with flexible types.

In view of the above, it becomes important to determine, if possible, what probable use of our facility will be made by commercial vehicles, especially those in the heavier weight groups having wheel loads of 4,500 pounds and over.

Thanks to the Planning Survey mentioned above, which since 1936 has been engaged, in cooperation with the Federal Government, in the accumulation of facts and figures on the highways of the State, for the information of the highway executive and designer, we are now able to estimate these data closely enough for our purpose. We accomplish it in this way.

First, from the annual traffic count records which we have been maintaining for many years, it is possible to estimate with reasonable accuracy the probable total traffic per day which will use our highway for the next 20 years. As these traffic counts have separated commercial vehicles from the passenger car type, it is also possible for us to forecast the number of each type.

LOADOMETER FACTS ESTABLISHED

The Planning Survey engineers in their study of State highway traffic, established loadometer or weighing stations at certain carefully selected points throughout the State, and for a period of time weighed representative groups of commercial vehicles, axle by axle.

Thus they established two facts of particular use to us for our present purpose: First, the representative axle weight distribution of the commercial vehicles using a particular section of highway; and second, the average number of axles of the average trucking unit. In other words, if we know the weight distribution, by axle loads, of the commercial increment of the traffic as well as the average number of axles per vehicle, from these data we can compute the total number of axles for each weight increment which will pass over our facility for any given period.

By applying proper "weighted" factors to each number and weight group of axle loads we can arrive at the probable repetitions of an equivalent 5,000-pound wheel load which our pavement or surfacing must be designed to withstand for the period of its assumed useful life. We use these "weighted" factors for the reason that it is necessary to determine some common denominator to which we reduce our axle load determinations, for purposes of comparison and correlation. In our practice it is in terms of 5,000-pound wheel loads, for our design analysis of probable stress in our higher type pavements convinces us that they will stand unlimited repetitions of wheel loads of less than 5,000 pounds.

For the purpose of giving you some idea of the magnitude of the truck use of our highways, our studies have indicated there are some heavily traveled sections in the southern part of the State, where a total of over 20,000,000 equivalent 5,000-pound wheel loads may be expected in a 10-year

(Continued on page 15)

Tentative Highway Design Standards

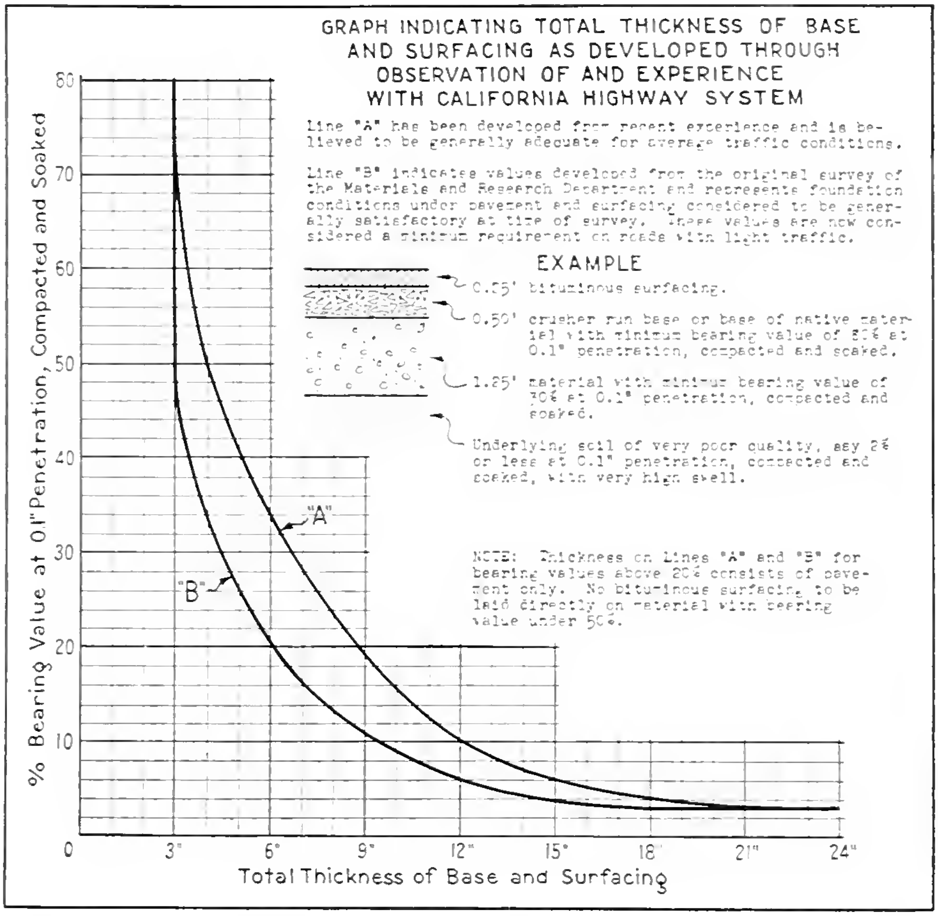
1. HEAVY INDUSTRIAL TYPE (10,000,000 equivalent wheel loads or over).

Outside traveling lanes to consist of 0.92′-0.67′-0.92′ portland cement concrete pavement, or 0.75′-0.50′-0.75′ lower cement content portland cement concrete base surfaced with asphalt concrete 0.25′ thick.

Inside or passing lanes to consist of 0.75′-0.58′-0.75′ portland cement concrete pavement, or 0.58′-0.42′-0.58′ lower cement content portland cement concrete base surfaced with asphalt concrete 0.25′ thick.

2. MEDIUM INDUSTRIAL TYPE (2,500,000 to 10,000,000 equivalent wheel loads).

All lanes to consist of 0.75′-0.58′-0.75′ portland cement concrete pavement, or 0.58′-0.42′-0.58′ lower cement content portland cement concrete base, or cement treated base varying in thickness from 0.50′ to 0.75′ in accordance with number of wheel loads and other conditions, with bituminous surfacing 0.25′ thick, or asphalt concrete pavement of adequate strength where subgrade is suitable and wheel load repetitions are under 5,000,000.



3. LIGHT INDUSTRIAL TYPE (less than 2,500,000 equivalent wheel loads).

Pavement to consist of 0.75′-0.60′-0.75′ asphalt concrete or some combination of local base materials surfaced with bituminous mixtures as the equivalent repetitions decrease below the top limit designated above, the design necessarily being subject to various local conditions of traffic and materials.

NOTE.—Figures 0.75′-0.58′-0.75′ indicate pavement slab 0.58′ thick, increasing to a thickness of 0.75′ in a distance of two feet at each edge of each lane.

Subgrades

Subgrade under portland cement concrete pavement or base to consist of a minimum depth of one foot of material with a minimum bearing value of 20% at 0.1″ penetration, compacted and soaked, and swell less than 3%.

Subgrade under cement treated base to consist of a minimum depth of one foot of material with a minimum bearing value of 20% at all penetrations, compacted and soaked, and swell less than 3%.

Subgrade under other combinations of surfacing as discussed in accompanying article.

Expansion Joints

Usual expansion joints in portland cement concrete pavement consist of $\frac{3}{4}$″ redwood boards with dowels at 120′ intervals, with weakened plane joints without dowels at 15′ intervals.

Usual expansion joints in portland cement concrete base consist of $\frac{1}{2}$″ redwood boards with dowels at 500′ intervals with weakened plane joints without dowels at 20′ intervals.

Road VI-Ker-4-E

Loadometer Station L-52

Limits: South of Famoso

Average daily traffic (1940) 6629)
Average daily commercial traffic 1940 1442) Average= 2163
Est. average daily commercial traffic 1950 2884)

2163 x 365 x 10 x 2.88* = 22,737,456 axle loads in 10 years

Wheel Load Groups

1. 4500 - 5500 10.71 % = 2,435,182 x 1 = 2,435,182
2. 5500 - 6500 9.61 % = 2,185,070 x 2 = 4,370,140
3. 6500 - 7500 11.96 % = 2,719,400 x 4 = 10,877,600
4. 7500 - 8500 6.02 % = 1,368,795 x 8 = 10,950,360
5. 8500 - 9500 3.40 % = 773,074 x 16 = 12,369,184
6. 9500 and over 0.91 % = 206,911 x 32 = 6,621,152

Estimated equivalent 5000# wheel loads in 10 years

Total estimated equivalent 5000# wheel loads in 10 years 47,623,618

Design repetitions (traffic in one direction) 23,811,809

REMARKS: Loadometer station at junction of Routes 4 and 33 at Famoso.
* Average number of axles per vehicle.

Panorama from Kings Canyon Highway showing new alignment, in middle foreground, of Squaw Valley route to Kings Canyon Park

New Modern Highway Unit Completed on Approach Road to Kings River Canyon

By E. T. SCOTT, District Engineer

IN ORDER to provide more modern highway facilities from Fresno to General Grant Grove section of the Kings Canyon National Park, the Public Roads Administration, the Division of Highways, and Fresno County have jointly constructed a new approach highway which is some 5 miles shorter than the old route by way of Dunlap and Pinehurst.

The Public Roads Administration constructed for the U. S. Forest Service some 12 miles of the route upon new alignment from the westerly boundary of Sequoia National Forest to a connection with the old road near Big Stump Lodge about a mile south of the General Grant Grove.

The Division of Highways has now completed a 3.1-mile connection with this new forest road between White Deer Road, just westerly of Dunlap, and the Forest Boundary. Fresno County improved 0.3 of a mile of the White Deer Road between the existing highway and the State construction so that the route is now completely modernized.

At a recent meeting the State Highway Commission voted on motion of Commissioner Iener W. Nielsen of Fresno, to keep the route open this winter providing the Forest Service extends the road beyond Cedar Grove, in the canyon, as originally planned.

The new alignment, grade and surfacing are up to modern mountain highway standards and are a marked improvement over the old route, making for a much more enjoyable trip to either the General Grant Grove or farther on up the scenic and rugged Kings River Canyon.

On the 3-mile section constructed by the Division of Highways, the maximum grade is 6 per cent while some of the grades on the old Dunlap-Pinehurst route were as high as 10 per cent. The alignment of the new route does not have the sharp curvature which exists on the old road as the minimum standard of curvature on the State's portion is a 700-foot radius and on the Forest section 300 feet. The maximum grade on the Forest section conforms to that used on the State's portion—6 per cent.

The work performed by the State consisted of constructing a graded roadbed 26 feet wide covered for its full width with selected material. The contract for grading, constructing drainage structures and placing the selected material was awarded by the Director of Public Works on May 8, 1940, and all work was completed on this contract on February 21, 1941.

On June 20, 1941, a second contract was awarded for applying a bituminous surface treatment to the selected material placed the year before. This work was completed on August 28, 1941.

The cost to the State for the construction amounted to $142,261 for the grading contract and $12,683 for applying the bituminous surface treatment, making a total of $154,944 for the improvement. The work was financed with State and Federal Aid Funds.

HEWN FROM SOLID ROCK

The completion of this highway to the General Grant Grove makes the rugged grandeur of the scenic Kings River Canyon Highway more available to Fresno and the San Joaquin Valley. From the northerly boundary of the General Grant Grove this road stretches into one of the most primitive areas yet touched by a modern highway.

The Kings River highway was hewn from the solid rock masses of this section of the High Sierra by 10 years of labor on the part of the Division of Highways. This construction involved the building of about 24.5 miles of road and its cost amounted to nearly $2,300,000.

With the completion of the approach road construction during the past two years, motorists may now travel with ease and comfort as far as Cedar Grove on the South Fork of Kings River and new joys await the California travelers who glory in the State's mighty Sierra along the entire trip.

Dropping deep into the canyon from heights among the clouds overlooking the expanse of the San Joaquin Valley to the west and High Sierra to the east, the Kings River Canyon Highway offers panoramic views of mountain grandeur not easily to be forgotten, such as views of mountain massives, peaks of sheet granite rising to dizzy heights, pinnacles and deep canyons, and all on a tremendous scale.

The highway into the canyon proper extends from the northerly boundary of General Grant National Park

New unit on recently completed realignment of State Highway section between Squaw Valley and Dunlap on Kings River Canyon Highway

Modern type mountain road in Squaw Valley area has 26-foot bituminous surfaced roadway

through Indian Basin, dropping down to Lookout Point, where a gorgeous panoramic view unfolds, and thence winds on down grade to Yucca Point. Here an inspiring view is to be had of the river named by the Spaniards in 1805, El Rio de los Santos Reys (River of the Holy Kings). From here one can see the confluence of the Middle Fork and the South Fork of the Kings River, both extending miles back into steep walled gorges, scoured by glaciers in ancient times.

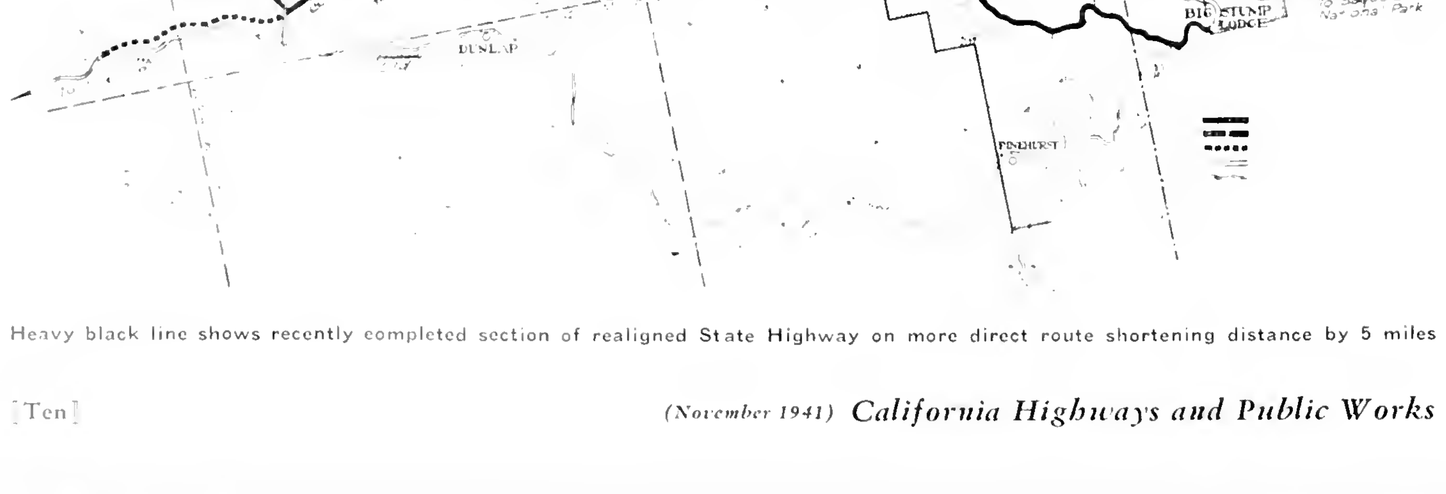
Winding down hill on gentle grades and easy curves the highway is carved in the granite of the canyon wall of the South Fork of Kings River. The river is finally reached at Windy Cliff, about 18 miles distant from General Grant Park.

Here the rock formation suddenly changes. A great limestone dike rises almost vertically to a height of 1,500 feet above the river, exquisite mountain sculpture. Nor are these natural carvings limited to the surface of the limestone formations.

Near Windy Cliff is to be found the entrance to Boyden Cave, a cavern extending several hundred feet into the great dyke. Galleries and grottoes carved in the limestone, ornamented with statuary of weird design; groups of stalactites and stalagmites, increase in numbers as one walks further into the cavern. Strong currents of air are felt apparently from crevices not yet explored, perhaps from an outside opening somewhere.

From the foot of the trail leading to Boyden Cave a large parking area has been provided for automobiles. At this point a bridge takes the high-

(Continued on page 25)



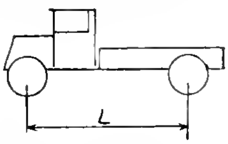
Heavy black line shows recently completed section of realigned State Highway on more direct route shortening distance by 5 miles

How Weight Laws Effective Jan. 1, 1942 Apply to Various Types of Vehicles

By STEWART MITCHELL, Assistant Bridge Engineer

THE changes made in the gross weight provisions of the Vehicle Code at the last session of the Legislature were described in the October issue of this magazine. The reasons for the change and the history of the studies and discussions leading to a much needed revision of the old law were also described.

In this issue the application of the revised weight regulations to various types of vehicles in common use on California highways is shown with the differences between the old and new laws described in detail.



TWO-AXLE TRACTOR OR TRUCK

Gross Weight=700(L+40) when L is less than 11.4 ft.

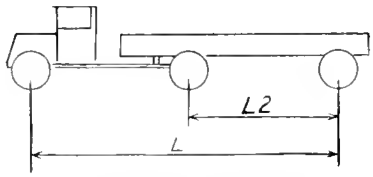
Under the old law, this type of vehicle is permitted a gross load of 26,000 pounds.

Under the new law the gross weight of the vehicle is practically governed by the maximum axle load. If both axles are loaded to 18,000 pounds, it is necessary for L to be at least 11.4 feet in accordance with Section 705 (b) (700(L+40)). However, because of loading and steering conditions, the load on the front axle seldom exceeds about 8,000 pounds and a total gross load of 18,000+8,000 or 26,000 pounds is permissible for any practicable value of L. (Note that the other provisions of the section do not place any additional limiting value and need not be considered in this particular case.)

Present owners of ordinary commercial vehicles of this type need only to be sure the gross load of the rear axle does not exceed 18,000 pounds and that neither wheel load exceeds 9,500 pounds.

Under the old law this type of vehicle combination is permitted a gross load of 43,000 pounds.

The permissible gross load of the tractor under the new law has been covered. The permissible gross load on the rear axle of the tractor and the

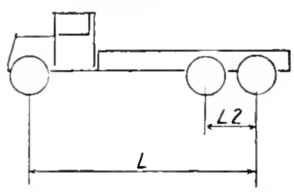


TWO-AXLE TRACTOR AND ONE-AXLE SEMI-TRAILER. 2S1

Gross Weight:
Combination=800(L+40) when L is less than 25 ft.
=850(L+40) when L is greater than 25 ft.
Two Rear Axles=700(L2+40) when L2 is less than 11.4 ft.

semi-trailer axle together can not exceed the maximum axle loads, and to get this load of 36,000 pounds it will be necessary for L2 to be at least 11.4 feet as already pointed out. If these axles are not this far apart the gross load on them will be reduced to the amount given by the formula 700 (L+40) as given in Section 705 (b).

Hence, present owners of ordinary commercial vehicles of this type, in addition to seeing that the axle and wheel loads do not exceed the maximum, must check the gross load of the rear axle of the tractor and that of the semi-trailer added together and see that it does not exceed that permitted by the formula 700(L+40) for the actual length L2.



THREE-AXLE TRACTOR OR TRUCK

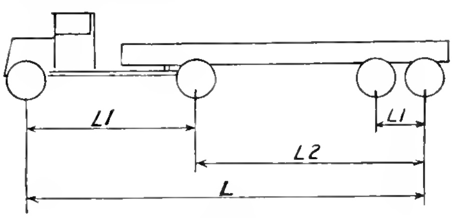
Gross Weight:
Vehicle =700(L+40) when L is less than 14 ft.
=800(L+40) when L is greater than 14 ft.
Dual Axles=700(L2+40)

Under the old law this type of vehicle is permitted a gross load of 34,000 pounds.

Under the new law, the gross weight permitted on the ordinary vehicle of this type is limited to a large extent by practical considerations. As in the case of the two-axle vehicle, the maximum front axle load is usually about 8,000 pounds. The allowable load of the dual axles is governed by the formula 700(L+40) of Section 705 (b) and in a common case where L2 is 3′ 9″, the allowable gross load on these two axles is 30,600 pounds—neither, of course, to exceed 18,000 pounds. Such a vehicle, with a gross load of 38,600 pounds would have to have an overall wheel base L of 15.2 feet if built after January 1, 1942, in accordance with the formula 700(L+40) of Section 705 (b). Existing vehicles can operate under this load until January 1, 1952, if this distance is 14 feet in accordance with Section 705 (d).

Present owners of ordinary commercial vehicles of this type are primarily concerned with the allowable load of the dual axles which will vary slightly with the customary small difference in distance between the axles. If they conform to this restriction it is only necessary to see that the wheel base is 14 feet or over, but if it is less the gross load of the vehicle must be checked by the formula 700(L+40) for the actual length L.

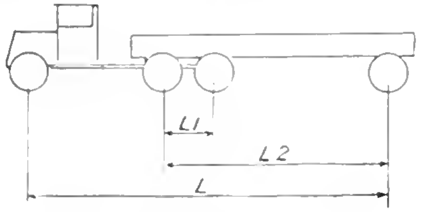
Under the old law this type of vehicle combination is permitted a gross load of 52,000 pounds.



TWO-AXLE TRACTOR AND TWO-AXLE SEMI-TRAILER. 2S2

Gross Weight:
Combination=800(L+40) when L is less than 25 ft.
=850(L+40) when L is greater than 25 ft.
Each Vehicle=700(L1+40) when L1 is less than 11.4 ft.
Last 3 Axles=700(L2+40) when L2 is less than 14 ft.
=800(L2+40) when L2 is between 14 and 18 ft.

The permissible gross load of the tractor and of dual axles, under the new law, has already been discussed. Adding together the maximum permissible load of the rear tractor axle (18,000 pounds) and a common maximum load of the dual axles of the semi-trailer of about 30,600, the total is 48,600 pounds. However, this total load is not allowed unless the distance L2 is 18 feet or more so that the provisions of Sections 705 (b) or 705 (d) will not apply. A load of 43,000 pounds is permissible on these axles under the old law and for this amount to be legal it is necessary that L2 be 14 feet or greater so that the provisions of Section 705 (b) will not apply.



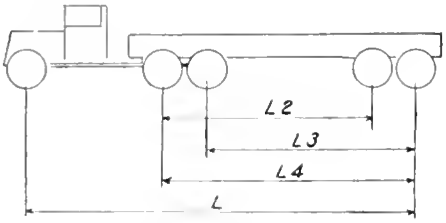
THREE-AXLE TRACTOR AND ONE-AXLE SEMI-TRAILER. 3S1

Gross Weight:

Combination	800(L + 40) when L is less than 25 ft. 850(L + 40) when L is greater than 25 ft.
Dual Axles	700(L1 + 40)
Last 3 Axles	700(L2 + 40) when L2 is less than 14 ft. 800(L2 + 40) when L2 is between 14 and 18 ft.

Under old law this type of vehicle is permitted a gross of 51,000 pounds.

The preceding paragraph referring to the permissible load on existing 2S2 vehicles also applies to this vehicle type.



THREE-AXLE TRACTOR AND TWO-AXLE SEMI-TRAILER. 3S2

Gross Weight:

Combination	800(L + 40) when L is less than 25 ft. = 850(L + 40) but not over 68,000 lbs. when L is between 25 and 45 ft.
Dual Axles	= 700(L + 40)
Axles 2, 3 and 4	800(L2 + 40) when L2 is between 14 and 18 ft.
Axles 3, 4 and 5	800(L3 + 40) when L3 is between 14 and 18 ft.
Last 4 Axles	700(L4 + 40) when L4 is less than 14 ft. = 800(L4 + 40) when L4 is between 14 and 18 ft.

Under the old law this vehicle is allowed a gross of 60,000 pounds.

Under the new law the load allowed on this vehicle type is dependent first on the distance L1 and secondly on the total wheel base of the combination L.

The determination of the permissible load on present owned vehicles of this type is as follows:

If L2 or L3 (whichever is the least) are 18 feet or greater, only two axles will fall within the 18 foot limit and Section 705 (b) will only affect each set of dual axles. Each set of duals then will be allowed about 30,600 pounds as previously discussed and the total load on the combination will be limited by the total wheel base, L, in the formula W=850(L+40) of Section 705 (e).

If L2 or L3 is between 14 and 18 feet and L4 is 18 feet or greater, the total load on axles 2, 3 and 4 can not exceed the amount given by the formula of Section 705 (d), (W=800 (L+40) where L=L2) nor can the total load on axles 3, 4 and 5 exceed the amount given by the same formula where L=L3. Also the total load on the combination is restricted by the formula W=850(L+40) where L is the total wheel base of the combination.

If L4 is between 14 and 18 feet, the total load of the last four axles of the combination will be determined by the formula W=800(L+40) where L=L4. In the rare instance where L4 is less than 14 feet the load on these four axles must be determined by 700(L+40). In neither of the last instances will it normally be necessary to check the total wheel base against the formula of Section 705 (e).

Two-axle trailers are allowed a maximum load of 18,000 pounds on each axle or a total of 36,000 pounds provided their wheel base is at least 11.4 feet. Where less than this amount the load is limited by the formula of Section 705 (b): 700(L+40).

The existing three-axle trailer is limited by the formula 700(L+40) applied to the dual axles and also applied to the three axles of the vehicle when its wheel base is less than 14 feet. When the wheel base exceeds 14 feet, the total on the trailer is determined by the formula 800 (L+40) in accordance with Sections 705 (a) or 705 (d).

Existing truck and trailer combinations will generally be controlled

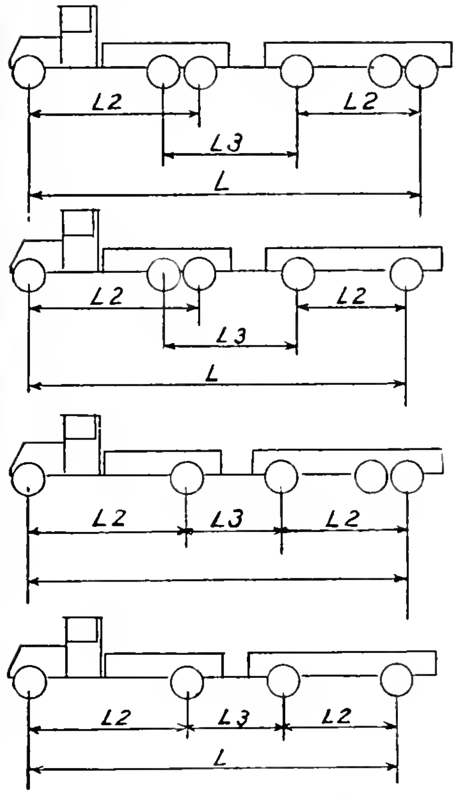
ALLOWABLE GROSS LOAD ON ANY GROUP OF TWO OR MORE AXLES BASED ON DISTANCE BETWEEN FIRST AND LAST AXLES OF THE GROUP FOR VEHICLES FIRST REGISTERED BEFORE JANUARY 1, 1942

Distance in Feet	Allowable Load in Pounds	Formula
3.5	30,450	W = 700 (L + 40)
3.75	30,625	
4.0	30,800	
4.25	30,975	
4.5	31,150	
5.0	31,500	
6	32,200	
7	32,900	
8	33,600	
9	34,300	
10	35,000	
11	35,700	
12	36,400	
13	37,100	
14	43,200	W = 800 (L + 40)
15	44,000	
16	44,800	
17	45,600	
18	46,400	
19	47,200	
20	48,000	
21	48,800	
22	49,600	
23	50,400	
24	51,200	
25	55,250	W = 850 (L + 40)
26	56,100	
27	56,950	
28	57,800	
29	58,650	
30	59,500	
31	60,350	
32	61,200	
33	62,050	
34	62,900	
35	63,750	
36	64,600	
37	65,450	
38	66,300	
39	67,150	
40	68,000	
45	68,000	W = 800 (L + 40)
46	68,800	
47	69,600	
48	70,400	
49	71,200	
50	72,000	
51	72,800	
52	73,600	
53	74,400	
54	75,200	
55	76,000	

ALLOWABLE GROSS LOAD ON ANY GROUP OF TWO OR MORE AXLES BASED ON DISTANCE BETWEEN FIRST AND LAST AXLES OF THE GROUP FOR VEHICLES FIRST REGISTERED AFTER JANUARY 1, 1942

Distance in Feet	Allowable Load in Pounds	Formula
3.5	30,450	W = 700 (L + 40)
3.75	30,625	
4.0	30,800	
4.25	30,975	
4.5	31,150	
5.0	31,500	
6	32,200	
7	32,900	
8	33,600	
9	34,300	
10	35,000	
11	35,700	
12	36,400	
13	37,100	
14	37,800	
15	38,500	
16	39,200	
17	39,900	
18	40,600	
19	47,200	W = 800 (L + 40)
20	48,000	
21	48,800	
22	49,600	
23	50,400	
24	51,200	
25	52,000	
26	52,800	
27	53,600	
28	54,400	
29	55,200	
30	56,000	
31	56,800	
32	57,600	
33	58,400	
34	59,200	
35	60,000	
36	60,800	
37	61,600	
38	62,400	
39	63,200	
40	64,000	
41	64,800	
42	65,600	
43	66,400	
44	67,200	
45	68,000	
46	68,800	
47	69,600	
48	70,400	
49	71,200	
50	72,000	
51	72,800	
52	73,600	
53	74,400	
54	75,200	
55	76,000	

by the restrictions of Section 705 (c), as applied to their combined wheel base L. They are allowed a total load 850(L+40) up to a maximum of 68,000 pounds for vehicle combinations with a total wheel base of 40 to 45 feet. If the total wheel base exceeds 45 feet, the gross load is governed by the formula 800(L+40) of Section 705 (a).



TRUCK AND TRAILER COMBINATIONS

Gross Weight:

Combination=850(L+40) but not over 68,000 lbs. when L is less than 45 ft.
=800(L+40) when L is greater than 45 ft.

Each Veh. =700(L2+40) when L2 is less than 14 ft.
=800(L2+40) when L2 is greater than 14 ft.

Dual Axles=700(L+40)

Center 2 or
3 Axles=700(L3+40) when L3 is less than 14 ft.
=800(L3+40) when L3 is between 14 and 18 ft.

THREE-AXLE TRUCK AND THREE-AXLE TRAILER
Under old law allowed 68,000 lbs.

THREE-AXLE TRUCK AND TWO-AXLE TRAILER
Under old law allowed 60,000 lbs.

TWO-AXLE TRUCK AND THREE-AXLE TRAILER
Under old law allowed 60,000 lbs.

TWO-AXLE TRUCK AND TWO-AXLE TRAILER
Under old law allowed 52,000 lbs.

In addition to these restrictions based on the total wheel base, the center concentrations of present truck trailer combinations must conform to Sections 705 (b) or 705 (d). The load on these center concentrations (L3 on the above sketches), shall not exceed 700(L+40) when L3 is less than 14 feet, nor 800(L+40) when L3 is between 14 and 18 feet.

State-owned Toll Bridges Continue to Show Large Traffic Increases in October

TRAFFIC on the three State-owned toll bridges continued at a high level throughout the month of October.

The daily average on the San Francisco-Oakland Bay Bridge was 56,464 vehicles, representing an increase of almost 23 per cent over the record of October, 1940. The heaviest single day's traffic occurred on Saturday, October 11th, when 69,210 vehicles crossed the bridge.

On the Carquinez Bridge the traffic was 13,783 vehicles per day, indicating a gain of 53 per cent over the same month of last year.

The Antioch Bridge, with a daily average of 888 vehicles, showed an increase of 37 per cent over the record of October, 1940.

The vehicular traffic for October, 1941, on the San Francisco-Oakland Bay Bridge and the Carquinez and Antioch bridges is tabulated below:

	San Francisco-Oakland Bay Bridge	Carquinez Bridge	Antioch Bridge
Passenger autos and auto trailers	1,564,584	383,419	19,601
Motorcycles and tricars	5,248	1,086	64
Buses	46,429	5,973	190
Trucks and truck trailers	91,124	36,533	7,618
Others	42,994	250	64
Total vehicles	1,750,379	427,261	27,537

Highway Fund Bill Waits President's Signature

As this issue goes to press word has been received from Washington that the $220,000,000 federal highway appropriation bill has been approved by congress and awaits the president's signature.

California is certain to receive more than $1,000,000 for strategic highways alone, said State Highway Engineer Purcell, and a substantial amount for access roads.

The bill would provide $50,000,000 for strategic network highway projects which would be allocated on a matching basis with the federal government paying 75 per cent of costs; $150,000,000 for military access roads with no matching funds required; $10,000,000 for flight strips with no matching funds needed, and $10,000,000 for plans and surveys to be allocated to the states on a fifty fifty matching basis.

The State has between $25,000,000 and $30,000,000 worth of access road projects surveyed and ready for contracting. These will be submitted to the federal government as soon as the appropriations measure becomes final.

National Defense Demands Will Curtail Development of Highways

(Continued from page 3)

increase in gas tax revenues, may alter conditions. This increase, however, is not as great by one half as is our increase in costs.

Taking into consideration these increased costs and considering our increased revenue, it is our best judgment that at the present time major projects in the existing budget amounting to between four and five million dollars, will have to be eliminated.

I hope the people of California will understand the conditions that exist. The Department of Public Works and Governor Olson will do everything within our power to meet the highway problems with which we are confronted with the least possible inconvenience to the people of California.

"They say that brunettes have sweeter dispositions than blondes."

"Well, my wife has been both and I can't see any difference."—Recorder.

Man (in locker)—Did you ever do any public speaking?

Chap (on stool)—Well, I proposed to a girl in the country over a party line.

San Rafael Viaduct and Two Major Projects Dedicated in Redwood Empire

RAIN in torrential quantities failed to dampen the spirits of Federal and State dignitaries and officials and citizens of counties of the Redwood Empire who participated in the dedication on November 2d of three major highway projects in Marin and Sonoma counties.

Ceremonies arranged by the Redwood Empire Association were held in the City of San Rafael to celebrate near completion of the $675,000 San Rafael viaduct, which breaks a serious traffic bottleneck in the heart of the city; at Petaluma to dedicate the new four-lane sections of highway south and north of Petaluma and at Sebastopol commemorating the opening of the new Luther Burbank Memorial Highway between Santa Rosa and Sebastopol.

Representatives of the Army and Navy and the U. S. Public Roads Administration joined with the California Highway Commission, officials of the State Department of Public Works, city and county officials of San Francisco, Marin, Sonoma and Mendocino and representatives of chambers of commerce of San Rafael, Petaluma, Santa Rosa, Sebastopol and San Francisco in the series of dedicatory ceremonies.

The celebration began on the southern end of the San Rafael viaduct at 10 a.m. with a program of speech making. The viaduct provides a four-lane divided highway over approximately five city blocks of residential and industrial property in San Rafael, providing five grade separations which will speed up traffic through the city and eliminate dangerous congestion. The structure occupies the channel of Irwin Creek, a stream which carries the runoff from practically all the streets in the eastern portion of San Rafael. It has a total of 67 spans, varying in length from 17 feet to 57 feet 6 inches. It is 2,207 feet 6 inches in length.

The viaduct structure itself cost $402,000; the roadway work, $153,000; and the Linden Lane underpass, which carries traffic beneath the viaduct, $120,000.

Director of Public Works Frank W. Clark represented Governor Culbert L. Olson and the Department of Public Works at all three dedications. Clifford Bartlett, Vice President of the Redwood Empire Association, acted as master of ceremonies.

Speakers at the San Rafael viaduct included Clark; T. Fred Bagshaw, chairman of the Marin Board of Supervisors; Mayor William S. Nock of San Rafael; Clyde Good, President San Rafael Chamber of Commerce; George Schleicher, President Marvelous Marin, Inc.; Senator Thomas F. Keating, San Rafael; Assemblyman Richard H. McCollister, Mill Valley; Senator Herbert Slater of Santa Rosa; Colonel M. F. Davis, Commanding Officer of Hamilton Field; Captain H. G. Taylor, 12th Naval District; Supervisor John M. Ratto, San Francisco; Supervisor Ed. Haehl, Mendocino; Chief Administrative Officer Thomas A. Brooks, of San Francisco, representing Mayor Angelo J. Rossi; M. Goldman, Past President of the Redwood Empire Association; Colonel John H. Skeggs, District Highway Engineer, San Francisco; Hugo Newhouse, representing the Golden Gate Bridge and Highway District; Highway Commissioners L. G. Hitchcock, Santa Rosa; Amerigo Bozzani, Los Angeles; and Larry Barrett, Chairman, San Francisco; Levant Brown, Senior Highway Engineer U. S. Public Roads Administration; C. H. Purcell, State Highway Engineer; and Director Samuel Gardiner, San Rafael Chamber of Commerce.

Following the program of speeches in San Rafael, the officials, invited guests and attending citizens journeyed by automobile caravan to Petaluma, where luncheon was served in the Petaluma Hotel under the auspices of the Petaluma Chamber of Commerce. The occasion was enlivened by musical renditions by the Petaluma Municipal Band.

With Vice President Bartlett of the Redwood Empire Association again acting as master of ceremonies, short talks were made by the speakers who took part in the San Rafael viaduct dedication and greetings to the visiting officials were extended by Chairman E. J. Guidotti and Supervisor George Kennedy, Sonoma Board of Supervisors; Jasper S. Woodson, Mayor of Petaluma; Ralph Belden, President Associated Chambers of Commerce of Sonoma County; and H. C. Hazlett, President of the Petaluma Chamber of Commerce. John Olmsted, Editor of the Argus-Courier of Petaluma, spoke on behalf of the press.

MRS. LUTHER BURBANK VISITED

Following the luncheon, the caravan proceeded to Santa Rosa, making a brief stop at the home of Mrs. Luther Burbank, widow of the world-renowned horticulturist. The inclement weather made it impossible for Mrs. Burbank to journey on to Sebastopol, as had been originally intended.

Open air ceremonies which had been scheduled to be held on the new sector of the Luther Burbank Memorial Highway, were abandoned on account of rain and a program of music and speech making was staged in the auditorium of the Sebastopol High School. Music was provided by the Santa Rosa Junior College Band and the Drum and Bugle corps, Sons of American Legion.

Addresses of welcome were made by Supervisor Kennedy, Mayor Robert Madison of Santa Rosa, Mayor A. P. Sweetman of Sebastopol; President Belden, Associated Chambers of Commerce of Sonoma County; Dr. Carl Sawyer, Vice President Santa Rosa Chamber of Commerce; Archie Butler, Sebastopol Chamber of Commerce; Senator Slater of Santa Rosa; and Assemblyman McCollister of Marin County.

BANQUET AT SAUSALITO

Speakers throughout the day paid high compliments to General Manager Clyde Edmondson, of the Redwood Empire Association, and members of

(Continued on page 21)

Official group at San Rafael Viaduct dedication: (L to R) Mayor W. S. Nock, Major W. C. White, U.S.A.; Col. M. F. Davis, U.S.A.; Public Works Director Frank W. Clark; Amerigo Bozzani, Highway Commissioner; Chairman Larry Barrett, Highway Commission; Col. L. W. White, U.S.A.; Capt. H. G. Taylor, U.S.N.; State Highway Engineer Purcell; L. G. Hitchcock, Highway Commissioner

Designing Foundation Courses for Highway Pavements and Surfaces

(Continued from page 6)

period. Obviously, nothing except an expensive and heavy industrial type of pavement can be expected to stand up under such punishment.

PAVEMENT TYPES REQUIRED

What type of foundation would be required for a pavement of this character? Based upon our present knowledge and information the following types of subgrade material are required for various types of pavement and surfacing.

PORTLAND CEMENT CONCRETE—At least a 12-inch depth of 20 per cent Bearing Value, minimum, at 0.1 inch, compacted and soaked. Swell less than 3 per cent.

ASPHALT CONCRETE—At least a 12-inch depth of 30 per cent Bearing Value, minimum, at all penetrations compacted and soaked. Swell less than 3 per cent.

BITUMINOUS SURFACINGS — Various depths, ranging from 6 inches to 24 inches, dependent on the underlying soils, the climate, and the traffic, of 30 per cent to 50 per cent Bearing Value, minimum, at 0.1 inch, compacted and soaked. Swell less than 3 per cent. The top 6 inches, in all cases to be of 80 per cent B. V. minimum, at 0.1 inch.

The B. V. or bearing values indicated refer to the California Division of Highways standard soil test determinations and have no relation to the actual supporting power of the material. The swell referred to is the expansion, under soaking, as determined by the California method. The thickness of blanket referred to means compacted thickness, over a definitely inferior soil of less than 10 per cent bearing value, having high swell.

There are some conditions where a lesser thickness of blanket or "ballast" course might do the job, but past experience indicates that good judgment will always profit by being conservative with respect to foundation courses, especially where they are to protect a considerable investment in pavement or surfacing. In a few cases, even greater thicknesses may be desirable or necessary.

It should be distinctly understood that the data above are admittedly empirical, but they have been determined from a considerable experience record in the Division of Highways. They are constantly being changed and modified by actual experience records and by tests and experimentation.

All of you are thoroughly cognizant, from sad personal experience, of the eternal and never-ending struggle to make one highway or street dollar do the work of two. Too often we have compromised with our foundation rather than with our surfacing or pavement with the result we have unhappy memories and a desire to forget—until next time.

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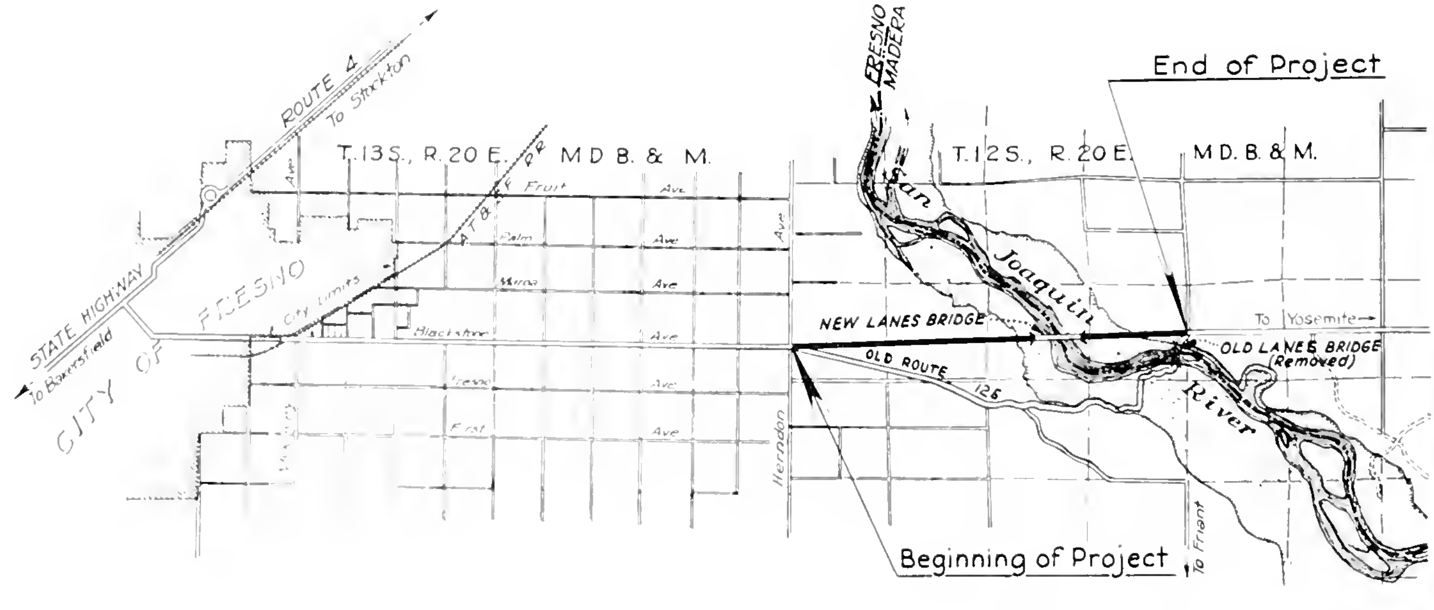
New Lanes Bridge across San Joaquin River on Fresno-Yosemite Highway is a 750-foot reinforced concrete structure

Two New Bridges Span San Joaquin River

SEVERAL hundred persons attended the dedication Sunday, October 12, 1941, of the new Lanes Bridge across the San Joaquin River. The new structure which spans the river is 750 feet long. In addition to this main bridge, there is a second structure 200 feet long across an overflow channel. The two bridges are connected by a 255-foot fill and are built on a revised alignment, which shortens the distance over the old State highway between Fresno and Yosemite Valley by eight-tenths of a mile.

Due to the destruction of one of the truss spans of the old Lanes Bridge by an illegal truck load, traffic between Fresno and Yosemite Valley was required to travel a county road through Friant, the distance by way of Friant to Yosemite being about 5½ miles greater than by State highway route.

The opening of the new section of State highway on Sunday had been well publicized and a great many motorists drove out to visit the realigned road and the bridges. Naturally the opening of this highway



Top and bottom pictures show sections of revised alignment on State Highway between Fresno and Yosemite Valley. Center—Reinforced concrete bridge over San Joaquin overflow connected with Lanes Bridge by 255-foot fill. The bridge is 200 feet long unit, which completes the last link in the Fresno-Yosemite Highway improvement so far as new alignment is concerned, was a welcome event to the motorists.

The dedication ceremonies were presided over by Paul Staniford, chairman of the roads and resorts committee of the Fresno Chamber of Commerce. Superior Judge Ernest Klette of Fresno was the principal speaker and told some of the early history of highways and bridges in the San Joaquin Valley. He recalled the transportation conditions as they existed when he was a boy. At that time the San Joaquin River was crossed by fording the river during low water, or by means of ferryboats when the water was high.

Representatives of road committees of both Madera and Fresno Counties, together with county supervisors, representatives of chamber of commerce, as well as other county and State officials were introduced.

The history of the naming of the original Lanes Bridge was told by Arthur H. Drew, District Grand President of the Native Sons of the Golden West.

The formal opening of the new structure across the San Joaquin River, together with the new section of highway, was accomplished by the cutting of a ribbon by Barbara Nielsen, daughter of State Highway Commissioner Iener W. Nielsen. Miss Nielsen was assisted by Mildred Edwards.

The bridge across the San Joaquin River, and the overflow structure, were constructed by the Campbell Construction Company at a cost of $131,935.60. Both bridges are of reinforced concrete construction, the piers being supported by piles.

Fredrickson Brothers, contractors, constructed the highway approaches to the new bridges, from the intersection of Blackstone Avenue and Herndon Avenue northerly across the San Joaquin River to a point 1.6 miles north of the Fresno-Madera County line. The oiled surface of road-mix type was subcontracted by the Oilfields Trucking Company.

L. Tresidder was resident engineer for the Division of Highways on the road construction, while A. J. Stocks represented the Bridge Department as resident engineer on the construction of the bridges.

Sally (in car)—Does the moon affect the tide?

George—No, just the untied.

Barbara Nielsen (left), daughter of Highway Commissioner I. W. Nielsen (center), cuts ribbon at Lanes Bridge dedication, assisted by Mildred Edwards

Foundation Courses for Pavements and Surfaces

(Continued from page 15)

There is every reason to believe that your own particular conditions and service records will indicate some modifications, but I beg of you, base them upon facts. Know the actual physical characteristics of your soils, your traffic loads and volumes and you will then be in a position to make an intelligent modification, if such is indicated.

We are even now engaged in a comprehensive experiment involving the construction of several types of pavement upon a number of different character subgrades on a test track under carefully controlled conditions, for the purpose of further verifying and proving our design requirements. The results will probably not be complete until next year but will eventually be made available to all who are interested through our official publication.

In the previous discussion an attempt has been made to cover briefly certain essential information which we in the State Division of Highways believe is of vital importance preliminary to the design of either a foundation course, a pavement, or a surfacing, if a thoroughly satisfactory and economical result is to be secured.

Needless to say, there are still many roads and streets being designed and built upon no firmer foundation than the personal opinion and preferences of the responsible authority. Some of these will return a satisfactory period of service, but many others will fail and result in an economic loss which could have been avoided at a relatively small increase in the investment, by a more intelligent and thorough study of the conditions preliminary to the design.

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$283,200,000 Needed to Modernize Rural State Highway System, Says Official Report

SERIOUS inadequacies in California's 12,621-mile rural State highway system are revealed in a report on "California Highway Needs" submitted to Governor Olson by Frank W. Clark, Director of Public Works.

The report, prepared by engineers of the Division of Highways, shows that 8,231 miles, or approximately 65 per cent, of the mileage in the rural State highway system is below present-day standards as to width, type of surface, alignment, sight distance or some combination of such deficiencies.

California's rural State highway system represents an investment of approximately $433,000,000 for construction alone. Although in miles it is less than one-ninth of the total highway, road and street mileage in the State, it carries more than 30 per cent of the total vehicle traffic in the State.

Three main purposes are outlined in the report, namely:

SCOPE OF REPORT

To show clearly the extent to which the rural State highway system of California has been improved up to the present time, and what this improvement has cost;

To demonstrate the extent of deficiency of the present facilities with relation to necessary and desirable standards, and special requirements to meet the needs of California motorists and visitors now and for the future;

To present a detailed estimate of minimum funds required to bring the rural State highway system up to desirable standards and show the alternative which must be faced.

The report states the following facts:

LARGE TRAFFIC INCREASE

Traffic on California's rural State highway system has increased 46 per cent from 1934 to 1940. A further increase in traffic of about 24 per cent is looked for by 1950.

Reconstruction of the inadequate mileage to standards desirable and necessary for the needs of California motorists now and for the future will cost an estimated $283,200,000.

Some 842 miles of roads which are adequate at present will become inadequate because of traffic increases by 1950. Reconstruction of this mileage will cost the State an estimated $46,000,000.

PAVEMENT REPLACEMENT

Because of surface deterioration about 10 per cent of the total mileage in the rural State highway system must be replaced annually. This replacement is estimated to cost $34,600,000 by 1950.

At least 100 miles of rural State highways within metropolitan districts (exclusive of State highways in cities) will require improvement as freeways to relieve traffic congestion. It is estimated these improvements will cost $25,000,000.

Elimination of railway grade crossings with high accident records are an urgent necessity. It is estimated this will cost approximately $27,000,000.

928 UNSAFE BRIDGES

At least 928 bridges out of 3,436 on the rural State highway system are inadequate or unsafe for modern traffic and must be replaced at an estimated cost of $26,700,000.

The total cost of improving the rural State highway system to standards adequate for 1950 traffic is estimated at $442,500,000.

The total estimated cost of modernizing the rural State highway system by 1950 is approximately $251,600,000 more than the total income which will be available for construction during the next 10 years. On this basis the Division of Highways faces an apparent annual deficit of $25,000,000.

WHAT MOTORISTS PAY

California motorists at present pay an average of only about $30 a year per registered motor vehicle. This is less than the motorists of 44 other States pay in road user taxes. Of the $30 less than $12 is for the use on the rural State highway system.

The California rural State highway system has been underfinanced for 20 years. This has made it necessary to limit the standard of improvements, particularly of road surfaces with consequent high maintenance costs.

Mileage added to the rural State highway system by legislative action in 1933 practically doubled the responsibility of the Division of Highways without any compensating increase in revenues.

MILEAGE DOUBLED IN 1933

More than 54 per cent of the total inadequate mileage in the rural State highway system consists of routes that were added to the system by legislative action from 1933 to 1939. Over 79 per cent of such mileage is deficient.

About 7,700 miles or 61 per cent of the rural State mileage is in mountainous or rugged country where it is difficult and expensive to provide adequate sight distance for passing or even safe stopping distance for present-day speeds.

Some 2,869 miles of the rural State highway system are surfaced with over-age pavement. Many miles of obsolete roads are still carrying traffic far beyond their safe capacity.

Lack of funds will prevent the Division of Highways from improving highways in the War Department's National defense network to standards required for military use.

The work of improving the rural State highway system to fit 1950 traffic can not be accomplished if the present level of highway financing is continued.

SOME POSSIBLE ALTERNATIVES

The report suggests several possible courses of action for financial relief. One is to add no roads to the system until funds are available for their adequate improvement. Another is to undertake no construction on highways carrying a low volume of traffic. A third suggestion is to initiate measures to increase State highway funds so the highway system may be improved to a standard adequate for existing and anticipated traffic.

Needed financing, the report suggests, might be accomplished by increasing taxes on vehicles, motor fuel, or increased Federal aid allotments.

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Annual Convention American Association of State Highway Officials Held in Detroit

By AMERIGO BOZZANI, Member California Highway Commission

IN THE past 30 years I have attended a great number of National and State conventions, political, religious, business mens, and many fraternal orders, as delegate, executive committee member or spectator; but never before has a convention impressed me as did the convention of the National Association of State Highway Officials held at the Statler Hotel, Detroit, Michigan, from September 29th to October 3d, 1941.

Contrary to other conventions which are generally accompanied by a great fanfare, bands, drum corps, majorettes, or rival groups of men, striving to promote some candidate, or cause, that convention was very serious and dignified.

It was composed of over a thousand highly intelligent men, representing every State in the Union, who went there for the sole purpose of working out plans for improvement of highways and bridges, for faster but safer movement of traffic by intensive development of limited freeways and overhead motor ways to relieve traffic congestion and separate local from through vehicular traffic, by active collaboration with public authorities. In other words, to make America the safest place in the world for the 32 million vehicles which are now using our highways.

The arrangements for this successful convention, prepared by the committee headed by Governor Murray D. Van Wagoner, former Michigan Highway Commissioner, and Mr. Kennedy, were perfect in every detail. The auditorium itself had a real atmosphere of dignity. At the exact hour, the representatives of all the States in the Union, were in their designated places.

Immediately after the opening ceremonies, Governor Van Wagoner delivered an impressive welcoming address.

It was most remarkable to see all the committees at work between the various sessions of the convention. There was no rivalry among the members. Each was willing to give to the other the benefit of his findings, and freely exchanged opinions in the most harmonious atmosphere. I took my place as a student, for the reason that I did not belong to any committee, but I had the opportunity of going from one committee room to another, and learned a great deal. I inspected the many delicate instruments of the research department and laboratory and was extremely amazed to see the great progress in this line of endeavor.

Resolution Adopted by A. A. S. H. O. Convention

WHEREAS, The United States Senate has passed a bill authorizing the use of $20,000,000 for cooperating with the countries of Central America and Panama in constructing the Inter-American Highway; and

WHEREAS, The completion of such highway from the United States to Panama will facilitate international trade among all the countries and will add progressively to the measures necessary to the defense of the western hemisphere; therefore, be it

***Resolved:* That the American Association of State Highway Officials endorses the proposal to assist the Central American Republics and Panama and urges the Congress of the United States to act favorably on the pending legislation; and be it further**

***Resolved:* That the Secretary of the American Association of State Highway Officials shall send a copy of this resolution to each member of the Congress of the United States.**

The California delegation was one of the most outstanding, including State Highway Engineer, Charles H. Purcell, and Fred Grumm, engineer of Surveys and Plans, and I felt very proud of my State. The address delivered by Dr. L. I. Hewes, Chief of the Western Region of the Federal Bureau of Public Roads on the subject "HIGHWAY SOLVENCIES," was complete in every detail. I am making a recommendation to our Director of Public Works, Frank W. Clark to have copies printed, sending them to all the Assemblymen and Senators of our State in order to enlighten them on the subject. I am quite sure, after studying the report of Dr. Hewes, they will be very careful before taking any more roads into the State highway system.

The spotlight was thrown on the Arroyo Seco Parkway of Los Angeles for the reason that during the first eight months it demonstrated its safety value, and as a very sound economical investment. The 8.9 mile Arroyo Seco Freeway between Los Angeles and Pasadena completed within a year, cost about $560,000 per mile for a six-lane design. It is a good example of a solvent metropolitan freeway. Its daily average traffic for last August showed in excess of 25,000 vehicles.

Using the State-wide user revenue rate of $.00566 per vehicle-mile this freeway is earning $51,650 per mile annually or about 9.22 per cent on its initial cost because traffic is practically constant throughout the year. As soon as the last bottle-neck is eliminated from the Los Angeles River to Sunset Boulevard, the traffic will increase to over 35,000 per day, and give at that rate, a return on the investment of better than 12 per cent.

A great deal of praise was given to the engineers of the State of California, for this fine construction. Not only for its safety, but also for its beauty and the record time in which it was built.

This great project after 20 years of unsuccessful pioneering, was brought to a successful conclusion by the Administration of Governor Olson.

The report of Dr. Hewes, of the Federal Bureau of Public Roads, regarding the value of the construction of Freeways in the United States, which has already been conclusively proved, should be brought to the attention of our Legislators in order that the necessary funds would be provided for the construction of many more through the congested metropolitan areas, where most of the fatal accidents and others causing personal injuries occur, and many millions of dollars in property loss are sustained every year.

Another very important address, a copy of which should be sent to all our Legislators, was the one made by Robert B. Brooks, consulting engineer and member, Missouri State Highway Commission, St. Louis, Mo.

In conclusion, after reading many reports and hearing the many splendid addresses delivered at the convention, and visiting eight of the most outstanding industrial States in the East, and talking to hundreds of manufacturers, merchants, farmers, and thousands of plain citizens, I have become convinced more than ever that in the United States of America we are 20 years behind in highway construction to meet the requirements of modern transportation created by the automobile industry.

While I believe law enforcement and education are fine things, still I am convinced now, more than before, that the solution of our traffic problem lies in the hands of our engineers. The time has arrived when human life should be put before monetary value, and the United States should start to prepare now a master plan of a perfect system of transcontinental and super highways, the elimination of all dangerous railroad crossings, installation of divided and elevated clover-leaf curves, construction of freeways of the same type as the Arroyo Seco Parkway, wider use of high visibility, signs and signals. As Germany has built them for offensive purposes we should build them for National defense, saving the lives of a hundred thousand people, and the injury of millions and the property loss of billions.

California today is facing the gravest traffic problem of any State in the Union, due to the fact that we have about 12 per cent of the automobile circulation in the United States, and the necessity of a modern system of highways is very important, and every good California citizen should support the movement to increase the gas tax in line with other States in order to provide the funds to solve this great problem. When I say this, I advance only my personal opinion and not that of Governor Olson and his administration.

In other States which do not produce any gas or oil, but have a gasoline tax two, three, and four cents higher than California, the retail price is lower than in our State. California engineers with the money made available to them in the past years, have done a great job, and deserve to be highly complimented. But due to the tremendous increase of motor vehicles in number, weight, height, and width, this State is 30 years behind its necessary road facilities.

I am very happy to have attended this convention for the very important information I received and the statistics I gathered which will be very valuable to me in making my decisions as a member of the State Highway Commission when the time comes to give my opinion in matters pertaining to highways and traffic.

I want to compliment members of the engineering staff, and the legal staff of the State of California who attended the convention for their intelligent, hard work.

I want to thank our great Governor, Culbert L. Olson and our Director of Public Works, Frank W. Clark, for sending me to the convention, where I had the opportunity of acquiring valuable knowledge.

Resolution Adopted by A. A. S. H. O. Convention

WHEREAS, The desirability of building up a program of highway and street construction projects as a means of employing workers to be released from defense industries upon termination of the present National emergency, is recognized; now, therefore, be it

Resolved: **That the American Association of State Highway Officials directs attention to the intimate familiarity with highway improvement needs possessed by the State Highway Departments and the Public Roads Administration, and the effective cooperative relations already existing between such agencies, and recommends to the Federal Works Administrator that the services of these established highway and functioning construction agencies be employed to the fullest possible extent in directing the listing and planning of highway and street improvement projects to be included in such a backlog of public works.**

Purcell Again Honored By A. A. S. H. O. Convention

At the conclusion of the twenty-seventh annual convention of the American Association of State Highway Officials in Detroit on October 2, delegates representing every state in the country elected G. Donald Kennedy, Michigan's highway commissioner, president.

State Highway Engineer C. H. Purcell of California, former president of the association was elected member of the Executive Committee.

San Rafael Viaduct

(Continued from page 14)

his staff, who had so perfectly arranged the three dedication programs.

On Saturday evening preceding the programs in Marin and Sonoma counties, the Highway Commissioners and State, Federal and county officials, were tendered a banquet at the Alta Mira Hotel in Sausalito, where they were guests of the Sausalito Chamber of Commerce.

$283,200,000 Needed to Modernize Rural Highways

(Continued from page 19)

Actual abandonment by the Division of Highways of roads of purely local importance is also suggested as a course which may become necessary.

The report points out that if the Division of Highways should be forced to defer construction, the highway system would become more and more inadequate because although improvements may be deferred through necessity, increases in traffic volume are inevitable.

Bridge at Orleans Decorated as Beauty Prize Winner of U.S.

CALIFORNIA State and county officials joined with Eureka and Redwood Empire Association representatives, Saturday, September 13, 1941, in dedicating the new Orleans bridge over the Klamath River at Orleans.

Feature of the program was presentation of a plaque by the American Institute of Steel Construction designating the suspension span as the most beautiful steel bridge of its class (costing less than $250,000) constructed in the United States and opened to traffic during 1940.

The plaque is a large, decorative bronze plate with letters in relief reading "American Institute of Steel Construction. Annual Award of Merit. Most Beautiful Steel Bridge, Class C, 1940." It is attached to one of the bridge towers.

With the unveiling of the plaque by Howard A. Schirmer, structural engineer of the Bethlehem Steel Company, San Francisco, representing A. I. S. C., the new State highway bridge was formally dedicated.

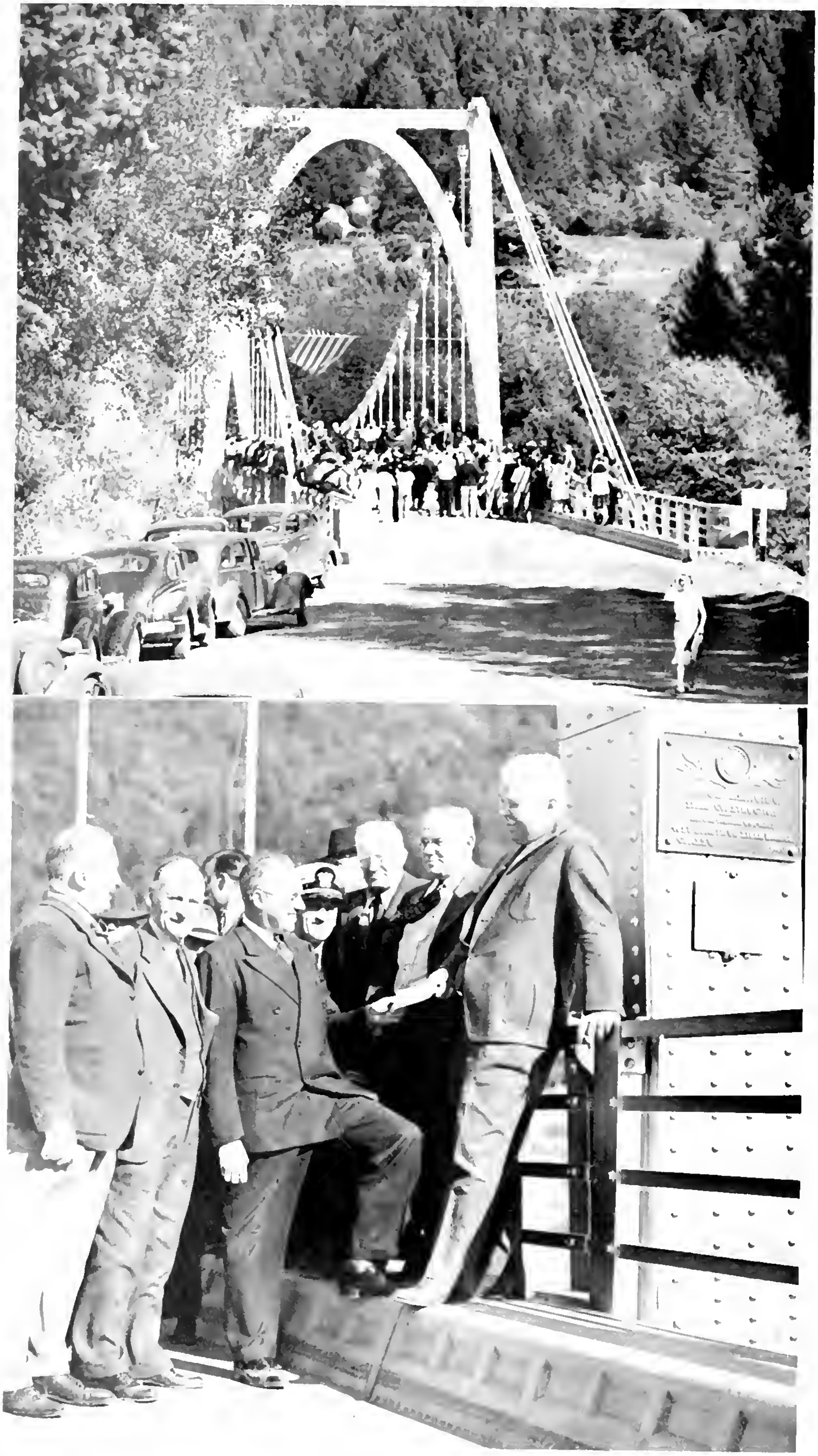
On behalf of the California Department of Public Works and the California Highway Commission, the plaque was accepted by F. W. Panhorst, bridge engineer for the Division of Highways.

An old fashioned barbecue with all the trimmings at noon preceded the colorful dedication ceremonies with Indians from the Klamath River reservation offering native dances, songs and entertainment.

Located on the world famous Klamath River approximately 100 miles east of Eureka on State Sign Route No. 96, amid a beautiful setting of forest-covered mountains and superb scenic splendor, the structure replaces an old obsolete suspension span with timber towers and 8-foot timber roadway. It is a modern 24-foot deck steel suspension bridge.

Designed by H. H. Gilbert of the Division of Highways, now a lieutenant commander in the U. S. Navy, the bridge was built under State contract by C. W. Caletti and Company of San Rafael. Construction began in November 1939 and was completed in September 1940.

(Continued on page 28)



At top—View of dedication ceremonies on beauty prize bridge across Klamath River at Orleans. Bottom—State Bridge Engineer F. W. Panhorst being presented with award by American Institute of Steel Construction. Note plaque on bridge tower upright

Divided Highway Unit Completed on U. S. 99 in Fresno Co.

By R. S. BADGER, District Construction Engineer

ANOTHER divided highway unit in the progressive improvement of the Golden State Highway, U. S. 99, through the San Joaquin Valley was completed September 2d in Fresno County by the Division of Highways.

The new unit covers a distance of 4.7 miles from the northerly limits of Selma into the southerly section of Fowler. It consists of an additional 23-foot asphalt concrete pavement paralelling and separated from the existing two-lane highway by a dividing strip varying in width from six to 26 feet.

OLD PAVEMENT USED

The inside lanes are 12 feet wide and the outside ones 11 feet, with concrete curbs on the dividing strip.

In this project the old pavement is utilized to carry the northbound traffic while the new construction carries southbound vehicles, along a slightly elevated and perfected grade line. The pavement is bordered by seven-foot nonskid shoulders which clearly outline the traveled way and further safeguard traffic when pavements are wet.

It is noteworthy that on this contract, as in other divided road projects, it was generally feasible to save and utilize the major portion of the existing tree plantings. However, near intersections, in order to minimize accidents through better sight conditions, low growing shrubs only were used.

EXISTING BRIDGE WIDENED

The contract for this project was awarded by Director of Public Works Frank W. Clark on March 10, 1941. The cost was $151,916.80 and included the widening of a two-span, reinforced concrete girder bridge across Fowler Switch Canal.

Bud Baccus was Superintendent for Contractors Piazza and Huntley of San Jose. F. W. Howard was resident engineer and F. B. England was assistant in direct charge.

Divided sector of U. S. 99 between Selma and Fowler. New south-bound traffic lane on right. Old highway on left

New divided road construction saves and utilizes on division strip trees that bordered roadside of old highway

This type of improvement is a continuation of other units built in that section of Fresno County in the past few years, the first beginning south of Kings River Bridge on U. S. 99 and extending to Kingsburg. The next, of similar construction, was built from a point just south of Selma via a by-pass route to the northerly edge of that community.

During the 18 months from January 1, 1940, to June 30, 1941, traffic accidents in the United States resulted in 51,760 deaths, while during the same period air raid casualties in Great Britain totaled 41,900.

Foundation Courses for Pavements and Surfaces

(Continued from page 18)

In the trying days ahead of us we will undoubtedly be called upon, more and more, as engineers worthy of our heritage, to obtain the greatest possible value from the taxpayer's dollar. This can only be accomplished by applying these sound, fundamental principles which are anchored on a firm foundation of fact; and a firm and adequate foundation is necessary, whether it be for a pavement, a surfacing, or a fact.

Publicly Owned Utilities of California Show Net Earnings Above All Costs

PUBLICLY owned electric utilities of seven cities and two irrigation districts operating in Northern California have been subjected to a careful analysis by the State Division of Water Resources for the Water Project Authority of California. The utilities studied are operated by Alameda, Biggs, Gridley, Lodi, Palo Alto, Redding and Roseville, and the Modesto and Turlock irrigation districts.

The results of these analyses contained in a report just completed show that all of the utilities were operated in 1939 with substantial net earnings over and above all costs. The report states "from the information available the earning position of all of these utilities has been favorable throughout the entire period of operation of these systems."

Other conclusions set forth in the summary analysis are:

POWER LARGEST COST

"Cost of power purchased wholesale from the Pacific Gas and Electric Company constitutes the largest item of operating expenses for the city-owned electric utilities, averaging 64 per cent of the total annual "out of pocket" operating costs.

"All the publicly operated electric utilities covered by this report are now dependent upon the Pacific Gas and Electric Company either for their entire electric power supply or for standby capacity or both.

"Of the seven city-owned electric utilities, four have no outstanding bonded debt and the remaining three have bonds outstanding amounting to from 2.3 to 12.1 per cent of book capital, which are being retired as they become due each year.

"Electric rates charged by the several publicly operated utilities are on the average similar to but with some higher and some lower than those prevailing for equivalent service in adjacent territory served by the Pacific Gas and Electric Company; and the character of electric service is comparable to that furnished by the private utility.

"The rates charged for electric energy by the publicly operated electric utilities do not reflect the cost of service but net earnings realized from revenues in excess of all "out of pocket" costs are transferred from the electric system accounts and used for other municipal or district expenses.

NET PROFIT OPERATIONS

"With one exception none of the publicly operated utilities covered by this report bear any expense for taxes, either State or Federal.

"The analyses indicate that all of the publicly owned utilities covered by this report could have paid State and Federal taxes comparable to the amount that would have been paid by similar privately owned electric utility systems in Northen California in 1939, in addition to all operating expenses and a full allowance for fixed charges of interest at 5 per cent, amortization and depreciation, and still have earned a net return ranging from 4 to 35 per cent of operating capital."

For the purpose of determining the over-all financial aspects of the operation of each of the nine publicly owned utilities, financial analyses were made reflecting not only the actual "out of pocket" costs shown in the official record for each utility, but including also full consideration of other fixed and operating expenses not reported by the utilities, either in part or whole. These analyses were made on two bases, one including an allowance for estimated State and Federal taxes and one without State and Federal taxes.

FINANCIAL ANALYSES MADE

In addition to "out of pocket" operating expenses as reported by each utility, the analyses include fixed charges comprising interest on estimated operative capital at an assumed rate of 5 per cent, amortization on a 3 per cent sinking fund basis predicated upon retirement of debt in 40 years, depreciation on a 3 per cent sinking fund basis predicated upon an average life of 25 years for distribution facilities.

On the basis of these data and with the assumption that the utilities had paid State and Federal taxes, the utilities would have made a net revenue in per cent of their estimated capital as follows:

	Per cent		Per cent
Alameda	4.60	Reddng	35.05
Biggs	4.13	Roseville	13.77
Gridley	14.19	Modesto I. D.	4.64
Lodi	14.12	Turlock I. D.	7.04
Palo Alto	13.66		

Without State and Federal taxes, but based on the same assumptions otherwise, the utilities would have made a net return in per cent of estimated capital in 1939 of:

	Per cent		Per cent
Alameda	10.40	Redding	48.78
Biggs	13.01	Roseville	22.06
Gridley	20.88	Modesto I. D.	8.88
Lodi	21.96	Turlock I. D.	10.77
Palo Alto	20.34		

The book capital of the electric distributing systems of the seven cities serving power amounts to $2,788,017.27 against which there is a bonded indebtedness of $161,382.77. Modesto and Turlock irrigation districts which generate their own power have a total book capital of $8,319,159.92 against which there is an outstanding indebtedness of $3,528,000.

SERVE 46,281 CUSTOMERS

The 9 utilities serve a total of 46,281 customers, the survey shows. Power is purchased by the city utilities entirely from the Pacific Gas and Electric Company. A total of 71,394,925 kilowatt hours of power is purchased by the cities at a cost of $819,716.70. The Modesto and Turlock irrigation districts which generate their own power at Don Pedro Dam purchase only a small amount from the Pacific Gas and Electric Company. In 1939, the year of the survey, the two districts used 94,322,889 kilowatt hours of electricity at an estimated cost of $361,792.70.

The Turlock Irrigation District, by virtue of its larger share in the Don Pedro works, generates all of its power at the lowest cost per kilowatt hour. Power costs the Turlock Irrigation District 2.20 mills per kilowatt hour. The Modesto Irrigation District which obtains the major share of its power from the Don Pedro plant was next in line for low-cost power. The district paid 5.55 mills per kilowatt hour.

In 1939 the Turlock District sold the Pacific Gas and Electric Company 77,622,920 kilowatt hours for which it received $263,125.97. During the same year, however, Modesto District found it necessary to purchase at wholesale from the Pacific Gas and Electric Company, 6,363,210 kilowatt hours of electric energy. The cost of the purchased power for the year was $63,233.73.

VARIED POWER RATES

Among the cities, Biggs paid the highest rate for its electricity with a rate of 11.18 mills per kilowatt hour. Other cities range from 10.09 mills per kilowatt hour for Gridley, to a low of 7.79 mills per kilowatt hour for Redding.

The total income of the electric utilities in 1939 ranged from $9,000 in the City of Biggs to $687,000 in the City of Alameda and approximately $800,000 for each of the irrigation districts.

For the cities the annual revenue per customer ranged from $46.62 in the City of Biggs to $92.99 in the City of Redding. Average revenue per kilowatt will range from a minimum of 2 cents in the City of Lodi to a maximum of 4.5 cents in the City of Biggs.

Annual consumption of electric energy per customer for all classes of service in the seven cities ranged from 1,036 kilowatt hours annually in the City of Biggs to a maximum of 4,353 kilowatt hours in Redding. Considering all classes of retail customers, the Turlock Irrigation District showed the largest average unit revenue of any of the nine publicly operated public utilities. It also showed the largest customer use of electric energy—5,708 kilowatt hours annually per customer—including the electric energy used by the district for drainage purposes.

Average revenue per kilowatt hour for domestic service only in the seven cities ranged from a minimum of 2.052 cents in Redding to a maximum of 5.235 cents per kilowatt hour in Biggs. These two cities also showed the extremes in consumption of electric energy per customer. Consumption in Biggs amounted to only 711 kilowatt hours, while in Redding it was 2,801 kilowatt hours per customer. Greatest domestic consumption per customer was in the rural area of the Turlock Irrigation District, amounting to 2,910 kilowatt hours annually.

Investment per customer in electric distribution facilities of the publicly operated utilities as related to the annual revenue per customer was shown in the report to be in line with the customer investments and related revenues for privately owned electric utilities under similar situations and conditions in Northern California.

Investment per customer in the publicly operated Redding system amounts to $89.08 as compared to a customer investment in the privately owned system in Salinas of $90.88. Annual revenue per customer in Redding amounted to $92.99 as compared to $95.25 in Salinas. Among the larger communities Alameda has an investment of $115.75 per customer with an annual average revenue per customer of $50.88. For Stockton, which is served by a private utility, the investment per customer amounted to $113.39 with an average annual revenue of $72.90.

Shovel and trucks completing construction on Kings River Canyon unit

Highway Unit Completed on Kings Canyon Road

(Continued from page 10)

way across to the northerly side of the Kings River and thence it follows along the river past Boulder Creek and by Grizzly Creek, where a high waterfall and spray from that stream can be seen through the trees.

At Deer Cove the highway constructed by the State comes to an end, but the road does not end here. The Forest Service has built the highway from Deer Cove on upstream to Cedar Grove. Here a large area among the trees has been prepared with all conveniences and comforts for a fine picnicking and camping grounds.

The highway along the river presents a scenic contrast to views from Lookout Point—winding gently along shaded aisles of a forest of dense growth, then breaking out into flowery meadows. In a rock-walled canyon, are groves of Oak, Incense Cedar, Laurel and Ponderosa Pine. And always towering above the woods, are polished domes and spires of granite, reaching upward while below, the restless mountain torrent is swirling down the gorge, its flow checked by deep silent pools, and hindered by long rapids and numerous cascades. This is the South Fork of the Kings River.

New Method for Fixing No-passing Zone Limits—Uses 2 Autos With Trailing Wheels

By BLAIR GETTES, Assistant Traffic Engineer

In a resurvey of no-passing zones by the Traffic and Safety Department of the Division of Highways the use of a new method for determining the zone limits has been successfully employed in Highway District IV.

The element of chance and error in establishing the beginning and end of the double stripes on highway hills and curves has been eliminated by specially designed equipment attached to the rear end of an automobile. Heretofore, these limit points have been located from available engineering data by a man on foot who could not accurately determine vertical curvatures and sight distances.

In District IV, ways and means of fixing limits which would be accurate, rapid and economical have been under consideration for some time, particularly because of the many points of restricted sight distance throughout the district and the very few installations in existence.

TWO AUTOMOBILES USED

In adopting a new method, it was necessary to cover the field rapidly to complete the work in advance of the regular repainting of center stripes, so that the laying of yellow stripe could progress in an orderly fashion and the amount of paint required be minimized.

In experimental tests, two cars were used to travel along the road and mark the limits of no-passing zones. Every physical condition existing at each location was studied, including the combination of horizontal and vertical curvature, which might affect the limits of a zone; structures, trees or cut banks which might have a bearing on sight distance, and any other combination of circumstances that could cause a difference in driver reaction.

Speed checks were taken at representative points on each route and section where there was an apparent need for the zone. These checks were so spaced as to provide a good average for each area where geographical and topographical conditions were consistent for a reasonable distance on either side of the checked points.

TRAILING WHEEL DESIGNED

After reaching the decision on methods to be employed, it was necessary to work out the details of maintaining a predetermined distance between the two cars. A trailing wheel that measured in feet rather than miles and which could be readily mounted on the rear bumper of any car, was designed and the experiment was ready for trial. One wheel was required for each car.

The next problem was communication between the two cars. The most satisfactory method would be via short wave radio telephone, but the difficulty of obtaining the necessary equipment and licenses on short notice dictated other methods. A public address unit was installed in the trunk of the leading car and a frame built to support the trunk door at a height that provided vision through the rear window with no screening of the speakers.

This method was used for the first few days but proved unsatisfactory due to noises from other traffic on the road that drowned out the system. A red spot lamp was installed in the rear window of the lead car connected to a button on the steering wheel and this was used for the balance of the work, with the public address system used to direct traffic which attempted to travel between the cars.

Automobile with flag precedes car with stripe marking equipment

THREE MEN IN CREW

Personnel consisted of three men, one in the leading car and two in the trailing car. The actual marking was first done by the second man in the rear car with paint brushes mounted on 4-foot lengths of bamboo and two small cans of paint, one white the other yellow, mounted on the running board. However, the drip from the brushes whipped by the wind made a mess of the rear fender which was difficult to remove after the day's run and a change was made to oil cans with 6-inch spouts.

The marker in the rear car sat in the front seat and opened the door slightly, leaned down and squirted a small amount of paint on the pavement near the edge. It is intended for future work to mount two pump oil cans on the rear bumper with flexible tube and piano wire controls so that one man in the rear car can handle the entire job.

The actual procedure of locating zones consisted of starting approximately 2,500 feet in advance of the first point of restriction, where the equipment was mounted and a determination made from the previously taken speed checks as to the sight distance required for the speed of travel on that section. A speed of travel would then be agreed upon—20, 25, or 30 MPH depending on the alignment and expected frequency of the points of restriction.

CHECKS BY SPOTLIGHT

The lead car pulled ahead the required distance and set to zero on the footmeter. The cars being the required distance apart the starting signal was given and both cars moved out accelerating as rapidly as comfortable to the agreed speed.

Check flashes were given with the spotlight at each 100 feet for the first 500 feet and each 500 feet thereafter until the end of the section was reached whereupon the rear car closed up on the front car and a check was made to be sure that wheel bounce or some weaving in the driving had not changed the relationship of the two instruments particularly at the higher speeds.

In practically all instances the difference was so minor that it could be disregarded. In two cases, however, the surface was rough and the disparity was sufficient to warrant a re-run at lower speeds.

Second car has loud speaker under trunk door to warn intercepting traffic

After reaching the end of a section or a series of restricted locations the same procedure was followed in the opposite direction and all points marked in like manner.

CONSOLIDATION OF MARKINGS

The next step was to consolidate the markings on the pavement and place a visual indication for the striping crew to follow. After running the section in both directions the trailing car started back and placed an arrow on either side of the existing single line at the beginning of the restriction in the colors to be painted in the respective positions, then at the points of change from one side to the other and finally at the end. The lead car during this time proceeded to the nearest culvert marker and starting from that known point logged the consolidated markings for a permanent record and for a check sheet for the striping crew.

Due to the magnitude of the work only the routes of reasonably heavy travel were marked. The light traveled routes will be run during the season when striping is not in progress and the zones will be marked next spring when repainting begins.

To facilitate rapid painting of the zones, the paint striping outfit was revised by adding a tank on the truck for yellow paint and by the addition of quick change valves on the striper to allow for changing color of one or more lines on the move.

STUDIES BEING CONTINUED

After experiment it was found more rapid to paint the single line throughout an entire section skipping the "No-passing Zones" and then to change the guns on the striper and paint the zones on the return trip. This was primarily because of the method employed in California where a single stripe is 4 inches in width and the double stripe is 9 inches in width consisting of three 3-inch lines, the center line consisting of black lacquer to provide an extreme contrast for additional visibility.

Studies are now being conducted where the zones have been installed to determine what degree of observance is being realized and to ascertain if the zones fit the conditions of traffic on the various routes. Should local usage indicate revisions at any point, these will be made and when they are repainted next spring they will be beaded for increased visibility.

It was not considered economical to bead on the first painting primarily because the major portion of the lines would be on unpainted pavement subject to excessive wear whereas the repainting will be over the existing paint that will provide a good base for a long lifed line.

This method of determining limits of "No-passing Zones" was developed to cover a large area in a short period with limited personnel. The only equipment purchased were the footmeters, all other equipment being furnished by the writer for use in demonstrating the feasibility of the plan.

Visitor—"Does your baby brother talk yet?"

Johnny—"He doesn't have to. He gets everything he wants by just yelling."—California Cultivator.

First Boy—"My father is very brave. On a hunting trip in Africa he killed five lions and an elephant single handed."

Second Boy—"That's not so much. My dad is really brave. He bought a coupe when mother wanted a sedan."

Bids and Awards for October, 1941

ALAMEDA COUNTY—A through steel truss bridge with timber deck to be constructed across Arroyo de la Laguna, 3.2 miles north of Sunol. District IV, Route 107, Section E. L. D. Tonn, Lodi, $17,675; F. Fredenburg and G. Moriconi, South San Francisco, $17,780; A. Frederick Anderson, Oakland, $22,000. Contract awarded to Kiss Crane Service, Berkeley, $13,263.

COLUSA AND SUTTER COUNTIES—The decks of two bridges across the Sacramento River and First Street at Meridian to be redecked. District III, Route 15, Sections B,A. Parish Bros., Sacramento, $28,758; P. F. Bender, North Sacramento, $29,802; L. D. Tonn, Lodi, $31,057; Kiss Crane Service, Berkeley, $33,399; Lee J. Immel, Berkeley, $37,311. Contract awarded to C. C. Gildersleeve, Berkeley, $28,607.

CONTRA COSTA COUNTY—Between San Pablo Creek and Carquinez Bridge, about 3.5 miles, existing pavement to be widened with portland cement concrete and with asphalt concrete on portland cement concrete base, and borders to be constructed of crusher run base with armor coat to be applied. District IV, Route 14, Sections A, B. Louis Biasotti & Son, Stockton, $110,882; N. M. Ball Sons, Berkeley, $114,449. Contract awarded to Lee J. Immel, Berkeley, $109,121.

HUMBOLDT COUNTY—Between 3.0 miles and 3.3 miles north of Garberville about 0.25 mile to be graded. District I, Route I, Section B. Parish Bros., Sacramento, $58,298; J. L. Conner & Sons, Crescent City, $63,447; Piombo Bros. & Co., San Francisco, $65,905; Poulos & McEwen, Sacramento, $66,504; Kiss Crane Service, Berkeley, $67,889; Clande C. Wood, Lodi, $69,922. Contract awarded to John Burman & Sons, Eureka, $56,805.

KERN COUNTY—Between 0.6 mile west of Bakersfield and Bakersfield about 0.4 mile to be graded and surfaced with plant-mixed surfacing on cement treated base. District VI, Route 58, Section L, Bakersfield. Louis Biasotti & Son, Stockton, $42,596; Griffith Co., Los Angeles, $43,912; Piazza and Huntley, San Jose, $46,241; J. E. Haddock, Ltd., Pasadena, $49,441. Contract awarded to George von KleinSmid, Bakersfield, $39,461.

LOS ANGELES COUNTY—On Rosemead Boulevard, between Las Tunas Drive and Longden Avenue, about 0.7 mile to be graded and paved with portland cement concrete. District VII, Route 168, Section C. Vido Kovacevich, South Gate, $49,866; Griffith Co., Los Angeles, $51,709; Oswald Bros., Los Angeles, $58,374. Contract awarded to J. E. Haddock, Ltd., Pasadena, $43,844.

LOS ANGELES COUNTY—At Figueroa St. in the City of Los Angeles, the steel portion of the superstructure of a bridge across Los Angeles River and over Riverside Drive and the tracks of the Southern Pacific Railroad to be constructed. District VII, Route 165. Contract awarded to Bethlehem Steel Co., Los Angeles, $268,804.

SANTA BARBARA COUNTY—Across Alamo Pintado Creek, about 4 miles east of Buellton, a timber bridge to be constructed. District V, Route 149, Section D. Dan Caputo, San Jose, $15,547; Combs Bros., Bakersfield, $16,155. Contract awarded to E. G. Perham, Los Angeles, $11,370.

SANTA CRUZ COUNTY—Between Watsonville and Rob Roy Junction, about 7.8 miles to be graded and surfaced with crusher run base. District IV, Routes 32, 56. Section Watsonville, B.D. A. Teichert & Son, Inc., Sacramento, $337,295; N. M. Ball Sons, Berkeley, $353,599; J. A. Casson, Hayward, $410,412; J. E. Haddock, Ltd., Pasadena, $464,038. Contract awarded to Parish Bros., Sacramento, $334,809.

SHASTA COUNTY—Between Bass Hill and Crespos, about 14 miles to be surfaced with plant-mixed surfacing on crusher run base and over existing surface, and about 0.3 mile to be paved with portland cement concrete. District II, Route 3, Sections B, C. Fredericksen & Westbrook, Sacramento, $346,005; Macco Construction Co., Clearwater, $381,780. Contract awarded to A. Teichert & Son, Inc., Sacramento, $320,330.

YOLO COUNTY—Between 2.5 miles east of Yolo Causeway and Washington Underpass, about 1.0 mile to be graded and paved with portland cement concrete. District III, Route 6, Section C. Parish Bros., Sacramento, $66,931. Contract awarded to A. Teichert & Son, Inc., Sacramento, $66,905.

Plan to Dedicate Pan-American Highway October 12, 1942

Washington, D. C.—(By Highway Information Service)—Travel by automobile from Argentina to Canada after October 12, 1942, was presaged by the Fourth Pan-American Highway Congress, held in Mexico City, September 15-24. A resolution passed by this conclave recommended that this date, which commemorates the 450th anniversary of the discovery of America, be set for the official dedication of the hemispheric highway.

Representatives of the North, South and Central American nations united their efforts to advance and coordinate the development of rural and urban highway construction throughout the Western Hemisphere. In addition to the official delegates designated by the various governments, representatives of numerous public institutions and highway officials and engineers attended as associate delegates.

Unification of traffic regulations in all countries served by the Pan-American Highway, including governmental examinations for driver licenses, was recommended by the congress.

Lima, Peru, was designated as the locale for the next meeting of the congress, which will be held in 1943.

Held concurrently with the highway congress was the Second Inter-American Travel Congress for the promotion of travel among the American republics.

Bridge at Orleans Prize Winner of U. S.

(Continued from page 22)

The suspended span is 360 feet long and there are 135 feet of reinforced concrete girder spans on the west and 170 feet on the east. Although traffic on this highway is comparatively light, it is subject to occasional very heavy loads of machinery, lumber, etc., so it was considered advisable to design it for the heaviest design loading used by the Highway Department.

Each of the main cables consists of four 3-inch 7 37 wire ropes arranged in an open group. These cables were designed for a dead load of 3,475 pounds per lineal foot of bridge and a uniform live load of 45 pounds per square foot of roadway. They were prestressed for one hour at 200 tons, then measured and marked at 100 tons, which load corresponded to approximately the dead load stress in the cables.

The bridge has a reinforced concrete slab floor on longitudinal steel stringers. The floor beams are framed into a 30-inch, 108-pound wide flanged stiffening girder. These girders were fabricated as chords of the dead load camber curve and were fully spliced at 36-foot lengths.

The steel towers contribute a great deal to the appearance of the structure and consist of two columns braced by elliptically shaped cross braces forming an arch over the roadway. The hinges at the tower bases rest on welded structural steel shoes.

Taking part in the dedication were: E. R. Green, district highway engineer; I. O. Jahlstrom, bridge construction engineer; C. C. Winter, resident engineer on the project; W. T. Norris, district engineer for the steel institute; Cario W. Caletti of San Rafael, contractor; Lieut. Commander Harold H. Gilbert of Burlingame, designer of the span; Senator Irwin T. Quinn; Assemblyman M. J. Burns; Supervisors George Cole, Len Yocom, Fred Anderson, George Lindley and Lloyd Brown; Vice President George Cloney of the Redwood Empire Association, Clyde Edmondson, manager of the association and Lautz Smith, secretary of the Eureka Chamber of Commerce.

What you don't owe won't hurt you.

State of California

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Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

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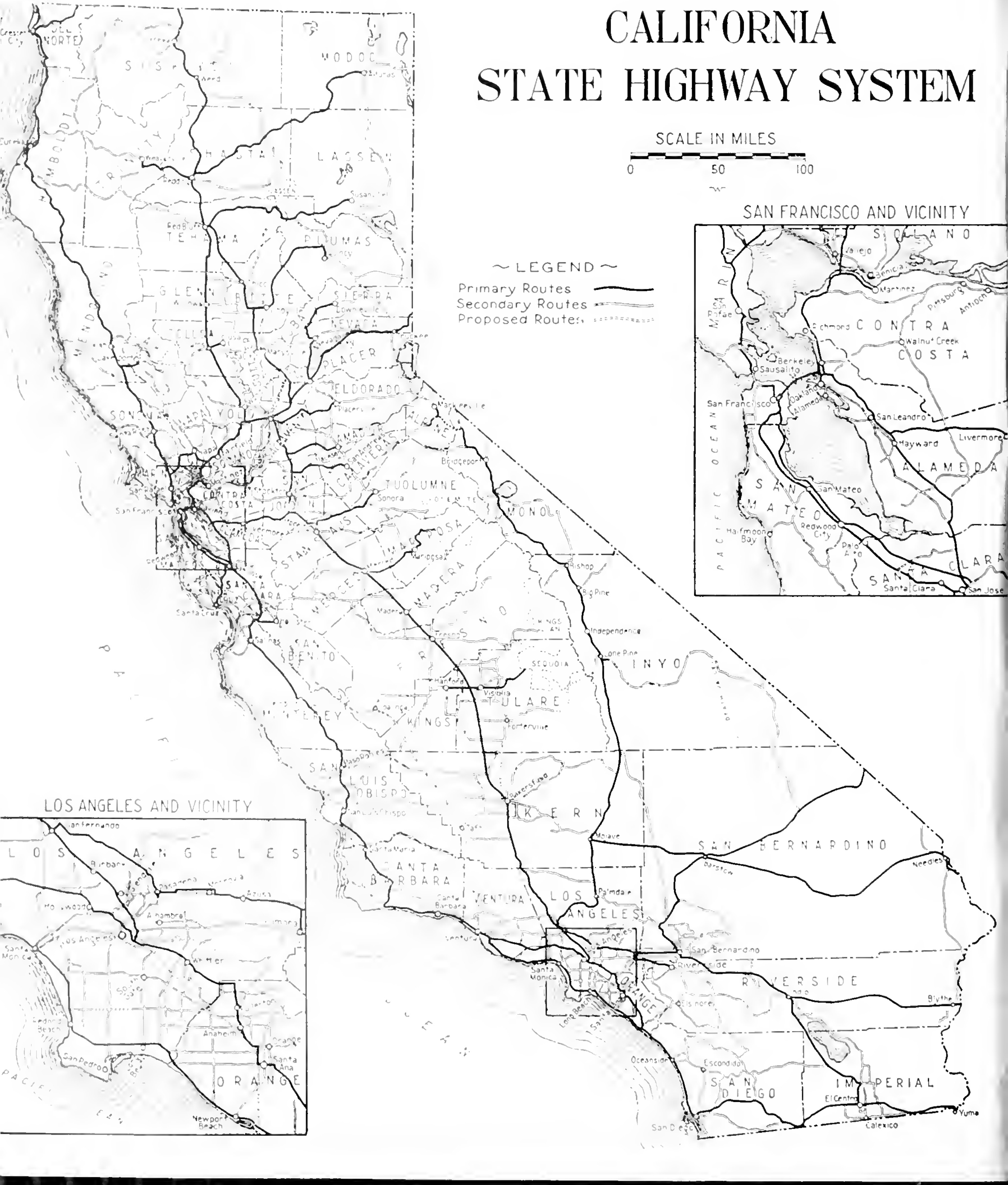

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Highway Budget for 1941-43 Biennium Revised to Meet Demands Imposed By National Defense Emergency

CONFRONTED by greatly changed conditions affecting highway construction occasioned by the National defense situation, such as increased costs of material and labor, priority restrictions and many other important factors, the California Highway Commission has been forced to revise the original budget for the current biennium submitted to Governor Olson in December, 1940, through Director of Public Works Frank W. Clark.

The principal factors in addition to increased costs that made budget revisions and adjustments obligatory included:

1—The compulsory application of budgeted Federal Aid and State highway funds to certain projects on the strategic highway system, as designated by the Federal Government.

2—The military access road program totaling $40,000,000 to be built by the State with Federal Funds on locations designated by the Secretary of War and Secretary of the Navy.

3—Fewer bids (sometimes only one bid) for advertised projects at much greater costs than the engineering estimates.

4—Federal priority regulations rendering unavailable, or subject to indefinite delays, building materials essential to the economic progress and completion of projects.

5—A larger increase in gasoline tax revenues than was anticipated when the budget was compiled, making possible additional needed allocations.

TOTAL EXPENDITURE INCREASED

After long study and discussion of the effect of these factors on the existing budget set-up and with the controlling purpose to make as few changes as possible, Chairman Larry Barrett and Commissioners Hitchcock, Nielsen, Vaughn and Bozzani met at Sacramento November 10th and adopted a revised budget which deferred certain projects, reduced others and added some new ones while increasing the proposed total biennium expenditure from $90,600,000 to $93,810,000.

The revised budget total includes $50,682,500 as compared with the original amount of $48,615,000 for highway construction and contingency reserve, rights of way and engineering costs; $18,875,000 for the cities' ½-cent share of the gas tax for streets and highways within municipalities compared with $18,250,000 and $24,252,500 for Administration, Maintenance of Highways and Bridges, Joint Highway Districts and Capital Investment including Shop Equipment and Maintenance Stations.

ADDITIONAL REVENUES AVAILABLE

The difference between the totals of the new and old budgets amounting to approximately $3,210,000 is due to increases of revenues above amounts estimated when the old budget was compiled. The gas tax increase contributed $2,500,000 of the difference, the balance representing motor vehicle fees.

In making a readjustment of funds to meet the new situation, the commission found it necessary to defer 34 projects in Northern California totaling $1,693,300, and 33 in Southern California totaling $1,281,260.

New projects numbering 34 and totaling $1,328,482 are listed for the North while the South gets 25 new projects amounting to $1,166,753.

As this magazine goes to press it is not known what portion California will receive of the $220,000,000 appropriation recently made by Congress and signed by President Roosevelt for Access Roads, the Strategic Network, Flight Strips, and Plans and Surveys in connection with the National Defense System.

The bill provides for the following distribution of these funds throughout the Nation:

1—Access Roads, $150,000,000, with no matching by State funds required.

Washington Holds Up Highway Jobs Not on Defense Projects

PENDING further instructions from Washington, no highway projects in California involving expenditure of Federal funds other than those certified as defense roads may be advertised for bids by the Department of Public Works, according to a telegram received by Director of Public Works Frank W. Clark from the United States Public Roads Administration on December 3d.

The telegram read as follows:

"Until further advice, please withhold approval of plans, specifications and estimates and consent to advertise for any pending projects regardless of funds involved except those certified as defense projects. Further advice will be sent to you soon. This will apply to any projects proposed for advertising this week."

The Division of Highways is awaiting a thorough interpretation of the telegram from the Public Roads Administration as this issue goes to press.

The instructions from Washington will affect the expenditure by the State of all regular Federal Aid moneys and feeder road and grade separation funds, according to Director Clark, who asked the Division of Highways to immediately prepare a list of all highway projects involved in the latest orders from Washington.

Several hundred thousand dollars of road projects already approved by the Highway Commission in various parts of the State probably will be affected.

2 Strategic Network, $25,000,000 to be allocated in accordance with regular Federal Aid formula and matched by the State on a 75–25 basis and $25,000,000 to be apportioned by President Roosevelt without regard to allocation and matched on a 75–25 basis.

3- Flight strips on strategic highways, $10,000,000, no matching required.

4- Plans and Surveys, $10,000,000, to be matched on a 50–50 basis

The only amount California is assured of receiving out of the $220,000,000 at this writing is $1,000,000 from the No. 2 allocation for strategic highways in accordance with regular Federal Aid formula.

SPECIFIC ALLOCATIONS AWAITED

The Division of Highways will not know what further money will be available to the State under the Access Road Program until specific allocations are made by the President and Federal Works Administration. Expenditures of these funds must be made under rules and regulations to be promulgated through the Public Works Administration according to priorities made by the Secretary of War and Secretary of the Navy.

The Strategic Network in California comprises approximately 5,900 miles of highways. In the main, this mileage overlaps the Federal Aid System which consists of 6,787 miles out of the 14,000 miles of the State Highway System.

The Access Road Program in this State includes recommended projects amounting to $10,000,000, but it is impossible to state at this time whether or not funds will be available for all of these projects. The great majority of these roads are located off the State Highway System and therefore State funds can not be expended for their construction. They are essentially roads to furnish access from main highways to military cantonments, camps, air fields, naval and marine bases and stations and to defense industrial areas.

ARMY AND NAVY SELECTIONS

The specific locations of these roads were selected as the result of numerous conferences with military officials held under the orders of the Army and Navy departments at various naval, marine and military establishments and attended by representatives of the Public Roads Administration, State Highway Departments, WPA and local city and county officials.

In the case of access roads to industrial sites, the designation is made through the Transportation Commissioner to alleviate traffic congestion where enormous defense industries are operating.

The Federal Aid Highway Act permits the use of Federal Aid Funds and Federal Aid Feeder and Secondary road funds for surveys and plans for access roads. Up to the present time, the State has spent approximately $1,200,000 of these Federal funds preparing for this $40,000,000 Access Road Program and plans and specifications are now ready for such road projects amounting to $12,000,000.

LOOKING TO FUTURE

The $10,000,000 allocated for the construction of flight strips adjacent to highways is to provide emergency landing places for air craft throughout the United States. These strips will vary from 300 to 800 feet wide and 3,000 to 8,000 feet in length. The locations are to be selected by the Air Corps and no matching funds are required.

The $10,000,000 for plans and surveys to be matched on a 50–50 basis is for work that will tie in with studies President Roosevelt has requested for carrying on Interregional Highway construction as a means for furnishing employment after the present emergency is over.

As to the priority regulations, materials used in highway construction come to the Division of Highways projects under an established priority basis.

A road leading to a cantonment takes the same preference rating as assigned to the cantonment. For example, McClellan Field carries a priority rating of A-1-e and the construction project of the viaduct in North Sacramento also carries a priority rating on materials of A-1-e.

ROAD AND BRIDGE PRIORITIES

Ordinary approach roads to Army camps have a priority rating of A-1-j; bridges on the Strategic Network are A-2; road work in connection with construction on any part of the Strategic Network carries an A-4.

Bridges on the Federal Aid System but not on the Strategic Network have a rating of A-3; and road construction projects on the Federal Aid Highway System but not on Strategic Network are A-7. Federal Aid Secondary projects are A-7 for bridges and A-10 for road construction. Maintenance operations also carry an A-10 rating.

A complete tabulation of the projects in the revised biennial budget detailing by counties the State highway route, location of the proposed improvement and cost of construction will be found on pages 18 to 27.

Summary of Changes in Biennial Budget

It will be recalled by the reader that in the November issue of this magazine, Director of Public Works Frank W. Clark stated the demands imposed upon the State by the National Defense Program would require some revisions and postponement of projects in the Highway budget as prepared and submitted by the California Highway Commission to Governor Olson in December, 1940. Mr. Clark stated that the specific details of the changes would be published in this issue.

In brief, the changes are as follows:

The total biennium expenditure of $90,600,000 as provided in the old budget has been increased to $93,810,000. The revised budget provides $50,682,500 for highway construction, engineering, etc., compared with $48,615,000 in the old budget.

The difference in the total between the old and new budget of approximately $3,210,000 is due to increases of revenue not anticipated when the budget was compiled.

The Highway Commission found it necessary to defer 34 projects in northern California totaling $1,693,300 and 33 in southern California totaling $1,281,260. New projects for northern California, numbering 34, total $1,328,482, and 25 new projects for southern California are listed at $1,166,753.

The proposed distribution of funds in the $220,000,000 appropriation recently passed by Congress and signed by the President are described in this article.

View of last stages of 30,000 cubic yard fill restoration at slipout on Los Gatos-Santa Cruz Highway.

Los Gatos-Santa Cruz Highway Slipouts Cost State $64,000

By GEORGE F. HELLESOE, District Maintenance Engineer

ACCOMPANIED by a roaring sound that resembled the uncanny booming noise of a major earthquake, two large dirt and rock fills on the Los Gatos-Santa Cruz Highway slipped out late last winter.

Engineers of the Division of Highways viewing the damage foresaw a restoration task of monumental proportions. Their reconstruction work is just now nearing completion at a cost of $64,000.

The two fills, 11 and 12 miles respectively north of Santa Cruz, in an earthquake fault area on State Highway No. 5, had successfully withstood the traffic loads imposed upon them since 1933, but proved unstable after a sequence of several unusually wet seasons during which the yearly inflow of rainfall into the hills above the highway was more rapid than the drainage therefrom by surface seepage and percolation into subterranean channels.

Last winter the elevation of ground water had risen to such an extent that the normally wet, earthquake-shattered foundation soil was subjected to a considerable hydrostatic head, causing a high degree of saturation. With the surface soil of the foundation in this lubricated condition, the central portions of these two sidehill fills slipped out.

Slippage was along circular arcs through the uniform material of the fill and, in the lower portion of the embankment, along the steeply sloped and softer surface of the foundation. In plain view the slipouts formed rough segments of a circle at roadway grade, which shape continued on down, but with an increasing taper. The shape of the sliding masses thus resembled the lower portion of a diagonal slice of an egg or an ellipsoid.

Slippage progressed at a rather slow rate and although several days elapsed from commencement to completion of the sliding, the failures were nevertheless awe-inspiring due

Completed repair of slipout at junction of old and new highways 12 miles north of Santa Cruz. Dark pavement marks area of slipout.

to the crashing noise which could be heard for miles at times of appreciable movement. The earthquake sound of the slipping masses was, in the later stages, augmented by the falling of redwood trees as the plastic, sliding fill material made its way for over half a mile (on the north slipout) down the steep, heavily timbered canyon.

It was indeed fortunate that the slippage lines did not extend beyond the centerline of the four-lane main traffic artery. Should such have occurred, temporary closure would have been inevitable and during restoration, summer traffic, with Sunday counts of nearly 16,000 and daily counts of over 1,000, would have been subjected to the hazard of narrow and shorter radius detours.

PRELIMINARY WORK

Before restoration could commence, the lower areas of the embankments had to be stripped of remaining loose fill material. This was strictly a bulldozer job as the material had to be moved to the sides and down the canyons. The material was moved just far enough to get it out of the way of the new embankments as it was desired that as large an amount as was reasonably possible be left at the toe of the embankment to serve as a buttress or counterweight.

The clearing of areas sufficiently large to commence filling operations would not have involved particularly large amounts of material. However, it was desired to expedite the installation of horizontal drains so such work would not delay or interrupt the placement of fills. This entailed stripping and depositing below the toe of embankment, not only a good share of the fractured portion of the remaining fill but also removal of all unsatisfactory foundation material.

An estimated amount of 20,000 cubic yards of preliminary stripping was done in the slipout located 11 miles north of Santa Cruz and approximately 12,000 cubic yards in the slipout 12 miles north. Over one-half of this item consisted of removing the softer top portions of the original foundations, it being considered essential that the new fills rest on as solid material as reasonably possible. Over a portion of the south slipout, it was necessary to excavate original ground to a depth of nearly 30 feet; but, in general, solid Monterey shales and sandstones were uncovered at depths of only a few feet.

SOIL TUBE BORINGS

As the stripping progressed, many one-inch soil tube borings were made to determine to what depths foundation stripping should be done. This enabled the work to be conducted more efficiently for the steep, slippery and constricted areas required that stripping progress from top to bottom or unnecessary access ramps along the sides of fills would have had to be constructed.

Although seepage was evident at many points over the slipout areas, it was not until stripping was well under way that free flow appeared. As the upper portions of the foundations were stripped of the compressed and somewhat impervious covering of fine material, flow estimated at 10,000 (south slipout) gallons per day commenced. Later, as stripping progressed downward and new outlets were opened, discharge from the upper springs subsided. Gradually, as the ground water gradient flattened, the total flow decreased but was appreciable throughout construction.

(Continued on page 6)

View of large slipout of fill. Installation of extensive drainage system under way. Inset shows outlets of 2-inch perforated pipe drains before covering with crushed rock.

(Continued from page 4)

With the foundations subjected to underground flow of this magnitude and the extensive, though inadequate, former underdrains destroyed, it was imperative that considerable drainage facilities be provided. This was of extreme importance, not only from a loss of investment standpoint, which would occur in case of a future slip-out, but from a traffic interruption standpoint as well. Failure of the fills being possible only by a reduction of the friction and cohesion factors of the soil composing them or their foundations, the proper measures would be to prevent such decrease in soil strength. Positive elimination of hydrostatic pressure in the area would prevent lubricating ground water from being forced into the interstices between the minute soil particles and the soil would maintain its strength.

HORIZONTAL DRAINS

To remove as much foundation ground water as possible, without resorting to pumping from numerous vertical wells, the evident solution was to drain the area back of the foundation surface with horizontal wells or drains. However, the comparatively fine nature of the foundation soil required that such drains be rather closely spaced to be effective. To install horizontal drains of types used in the past for water supply would have been too expensive to be feasible, and but for the comparatively recent development of a machine to bore long horizontal holes, some other solution would have had to have been resorted to.

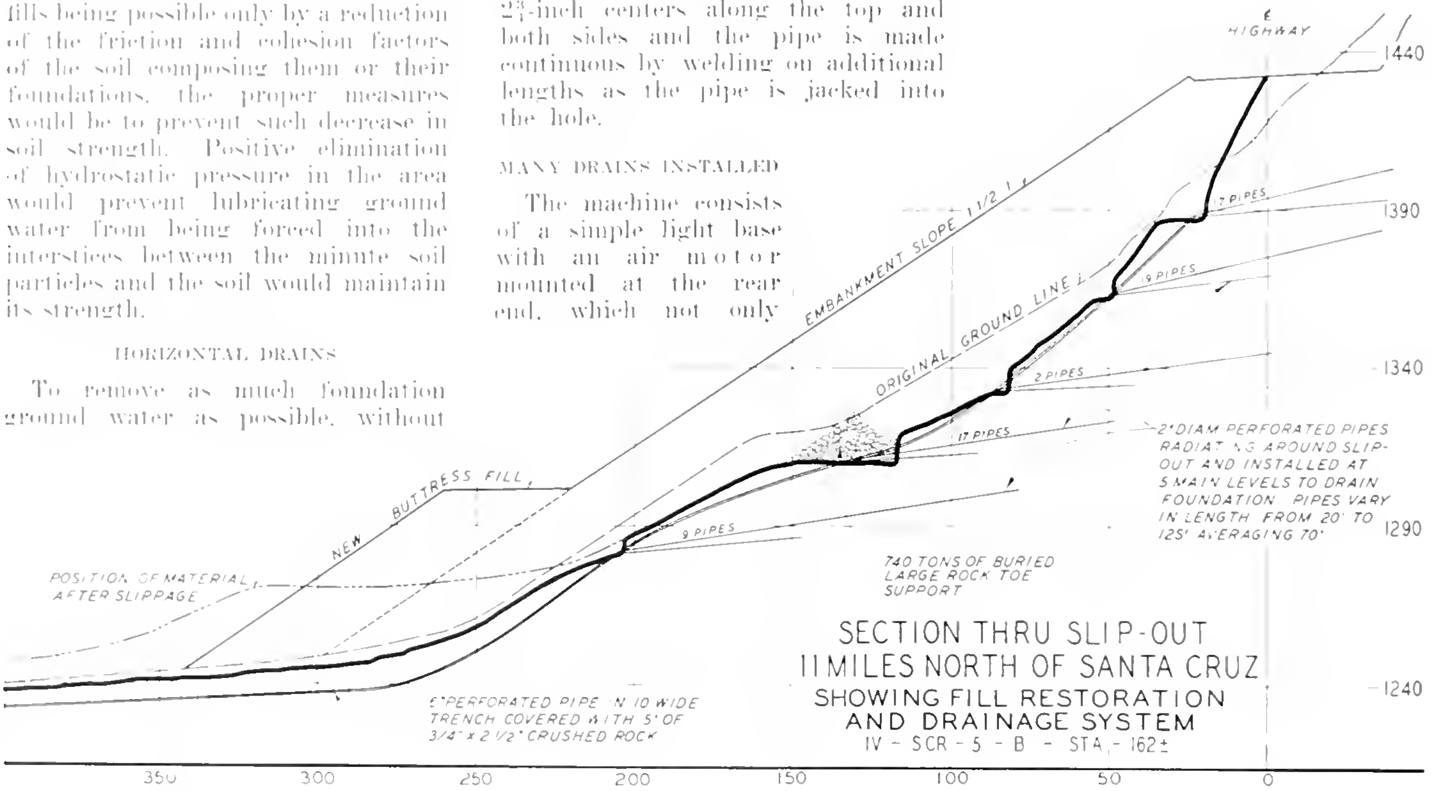
This hydrauger machine was developed primarily for installing nominal sized utility pipes under pavements, but with minor changes, the Division of Highways has successfully used it at several locations throughout the State.

As used during the past two years to drain slide areas, a 4-inch to 5-inch diameter hole is drilled approximately horizontally into the face of the area to be drained. Holes over 150-feet long have been drilled but the practical limit in most soils is less. After drilling the hole, a perforated 2-inch diameter asphalt-dipped, standard steel pipe with closed end is pushed or jacked into the hole. The perforations are at $2\frac{3}{4}$-inch centers along the top and both sides and the pipe is made continuous by welding on additional lengths as the pipe is jacked into the hole.

MANY DRAINS INSTALLED

The machine consists of a simple light base with an air motor mounted at the rear end, which not only rotates the drilling rod but forces a stream of water through the $1\frac{1}{2}$-inch diameter hollow drill. Drill rods have threaded ends and are in 5-foot lengths. The augur at the head end consists of a hard steel cutting bit with outlet holes for the water which washes the loosened soil out through the bored hole. Holes must be drilled on an incline in order that the water carrying the soil may flow out of the hole. For any drainage work, an outward slope is, of course, also necessary to prevent the casing pipe from clogging with silt which flows in with the ground water.

On this project a total of 32 drains was installed on the north fill and 64 on the south fill. They were located at five main levels on both slipouts with a few installed along the sides at intermediate levels where it appeared that appreciable water could be picked up. In the lower portions of the fills the pipes radiated from a working bench in the bottom of the trench. At higher levels, where the slipouts widened out, they were located at somewhat uniform intervals around the faces of the slipouts in a manner such that they would penetrate the entire steep foundation as uniformly as possible. Wherever seepage was still evident after installing pipes adjacent, additional drains were installed in an endeavor to intercept the subterranean flow.



SECTION THRU SLIP-OUT 11 MILES NORTH OF SANTA CRUZ SHOWING FILL RESTORATION AND DRAINAGE SYSTEM

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Pipe drains in the north fill varied in length from 17 feet to 125 feet and in the south fill from 17 feet to 141 feet, averaging 54 feet. In general, it was desired to install as long drains as possible and the shorter lengths actually installed were because either the hole caved before the casing could be installed or the hole could not be driven further. The former reason was most common, particularly in the south fill where 3,777 feet of hole was drilled and but 2,511 feet of casing installed. Approximately 2,000 lineal feet of pipe were installed on the north slipout.

The hydrauger was operated by two three-man crews on a double shift basis. Water was required in an average amount of 2,000 gallons per shift and had to be hauled over steep grades for five miles, as was likewise required for the large amount necessary to compact the fills. It was stored in tanks at the top of the fills and carried to the hydrauger by gravity through a 1-inch pipe.

The gross cost per foot for pipe actually installed was approximately $2.50 on the north slipout, which was completed first, and $2.06 on the other. This cost included only the connections to the 6-inch perforated lateral drains which connected to the main drains.

Because of the shape of the slipouts, the logical scheme for carrying the water from the horizontal drains was by means of lateral connections to a main drain running down the approximate middle of each slipout. Six-inch diameter galvanized and asphalt-dipped, perforated metal pipes were used for these conduits. The main pipe was laid in the very bottom of a bulldozer width 10-foot trench with the perforations on top so that the water running through the pipe would not disperse itself into occasional drier areas en route, which might possibly happen should the perforations be in the bottom of the pipe.

TONS OF ROCK REQUIRED

To prevent the entry of fill material into the pipe, to provide an alternate outlet in case of pipe failure and to drain the foundation and fill along these main drains, the entire trench was filled to a depth of five feet with ¾-inch to 2½-inch crushed rock. The upper ends of the main drains, and all laterals were covered with a windrow of crushed rock of equivalent cross-sectional area and the fills built around them.

The crushed rock covering of the main drain, as well as the lateral pipes, to which the horizontal drains were connected, was placed by means of a 10-inch diameter pipe chute. Hoppers were built at each slipout and the chute carried the rock to a point where a bulldozer could easily spread it over the main and lateral drains. For the north fill 2,500 tons of rock were required and 2,275 tons were used in the south fill, all at an average cost of $1.65 per ton in place. Approximately 750 feet of 6-inch perforated pipe were installed in each slipout at an approximate cost of $0.40 per foot.

Typical 2-inch drains connected with 6-inch collection pipe.

The total cost of all drainage features in both fills was $18,650, of which $10,200 was for 2-inch horizontal drains. For this expenditure the gratifying result has been the draining of approximately 14,000 and 3,000 gallons of water per day, respectively, from the south and north fill foundations.

In order that the efficiency of the drainage system may be constantly observed, several permanent wells were driven along the roadway at each fill. The ground water level can thus be determined and should an unusual rise occur, steps can be taken to correct the system.

As soon as the installation of horizontal drains had been completed in the lower portions of the north fill, the work of rebuilding the embankment commenced. It was desired to use the most siliceous material available for these embankments and this entailed a 3-mile haul along the main highway. The material was easily obtained from a borrow pit off the highway and traffic was not interfered with except by the left turn movements of the nine to twelve 4-cubic yard trucks.

The material was dumped over the side of the slipouts, moved into position by the bulldozer and compacted with another which constantly pulled a heavy sheepsfoot roller, resulting in an average relative compaction of over 95 per cent. The fills were brought up in level 6-inch lifts and the outside edges were thoroughly compacted by regularly running the sheepsfoot roller over the slopes of the fills. As the fills progressed, the rock drains were carefully covered with fill material and the tractors were not driven over them until they had been covered with at least two feet of fill.

Particularly, in the south fill, large portions of the original fill along the sides of the slipouts had been fractured and this loosened material was moved out and reconsolidated in 6-inch layers as the fills progressed. An estimated amount of 20,000 and 12,000 cubic yards, respectively, in the south and north fills was thus recompacted.

In the south fill, 740 tons of rock, averaging one ton in weight, were placed on the foundation at a level above the toe of the fill. This large rock increases the shearing resistance against sliding.

As a further insurance against slippage, the new fills were increased in width by 40 feet for a height of approximately 50 feet. These buttresses or counterweights greatly increase the resistance against slides of the circular arc type.

The total quantity of new fill was approximately 55,000 cubic yards, with 30,000 cubic yards going in the south slipout. The total cost of all work, including drainage facilities, was $64,000—of which $36,000 was for work on the south fill. All work was by Division of Highways' forces.

A salesman called on a big business man near the close of a rush day. When he was admitted, the magnate said:

"You ought to feel honored, son. During the day I have refused to see eleven men."

"I know," replied the salesman. "I'm them."

Arrows point to 2 tunnels separated by only 87 feet of highway being bored through Mt. Williamson on Angeles Crest Highway.

Boring 2 Tunnels on Angeles Crest Highway

By G. A. TILTON, Jr., Assistant Construction Engineer

ENGINEERS of the Division of Highways are making steady progress in handling the toughest construction job thus far encountered on the Angeles Crest Highway, State Highway Route 61, in the Sierra Madre Mountains in Los Angeles County.

The project unit now engaging the attention of the engineers is a 3.7 mile section from Cedar Springs to West Islip Saddle, involving the boring of two tunnels, one 675 feet and one 174 feet in length, separated by 87 feet of roadway.

Construction crews, working day and night, are penetrating solid rock, drilling, blasting and mucking six-foot rounds simultaneously in each tunnel with accelerating speed.

On the section between Cedar Springs and West Islip Saddle, there is very little soil and 80 per cent of the excavation must be blasted. Two inclined ridges projecting from the face of Mt. Williamson are so steep as to make tunnels necessary. Three of the four portal locations are on nearly perpendicular rock faces, 50 to 75 feet above the canyon floor, making it imperative to construct earth ramps before starting excavation.

FEDERAL-STATE PROJECT

Grading on the first two miles from the southwesterly end of the project to the tunnel is nearing completion. Work on the third mile can not be started until equipment can be moved through the tunnel. The cost of this 3.7 mile unit including tunnels will be in excess of $700,000 and will require over two years to complete.

The Angeles Crest Highway, traversing scenic mountain areas, is being built jointly by the United States Bureau of Public Roads and the State of California. The new route begins at the Foothill Boulevard and La Canada, extends up the Arroyo Seco and passes through the Sierra Madre Mountains to an easterly terminus in Los Angeles County Park at Big Pines, a recreational district that is reached now only by way of Palmdale or San Bernardino. Passing Buckhorn Flats, the new highway will serve the Pasadena public camp grounds. The shortest present route from Los Angeles to Big Pines is 107 miles in length. The distance by the Angeles Crest Highway will be approximately 64 miles, a saving of 43 miles.

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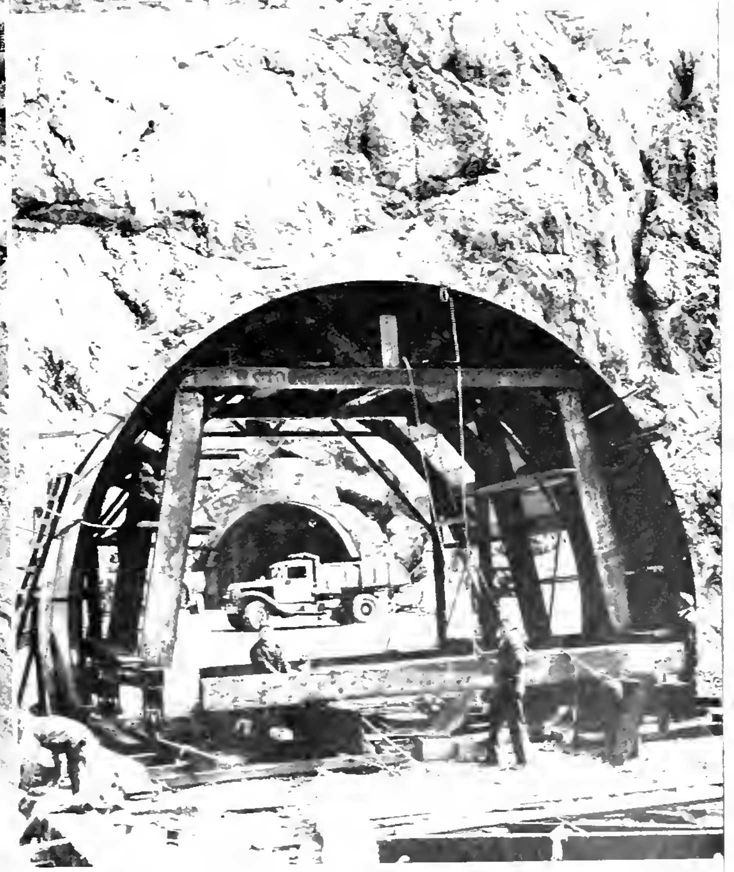

At left, portal of tunnel No. 2 through ridge of Mt. Williamson. This is a 14 x 14 foot pilot bore. At right, top, equipment mucking at main heading of tunnel No. 1, showing protective shell in use. Below, Construction yard between tunnels. Building concrete tunnel lining form. In the background may be seen the portal of tunnel No. 1.

Widening Sections of American Canyon Highway by Adding Two More Lanes

By R. E. PIERCE, District Engineer

SINCE the opening to traffic in November, 1936, of the so-called American Canyon Cut-off, extending from the Carquinez Bridge to Cordelia, there has existed a condition which has hampered the free flow of traffic, and which has been aggravated greatly by the continually increasing traffic. This traffic has practically doubled in four years, increasing from 4,996 vehicles per day in July, 1937, to 9,885 per day in July, 1941. Approximately 12 per cent of the traffic consists of trucks, stages, etc.

The condition that is hampering the free flow of traffic on the two-lane pavement and increasing the hazard is the reduced sight distance caused by vertical curves at the summits of two large cuts on both sides of a valley which is crossed by a large fill and a bridge. The grades on either side of the southerly summit are 6.22 per cent and 6.41 per cent, and there is a 6.10 per cent grade south of the northerly summit, and a 2.35 per cent grade north.

The principal cause of delay is due to the very slow speed of most of the trucks climbing these grades, the shortest of which is about one-half mile long, and the short sight distance which makes it hazardous to pass these slow vehicles.

The project now under way, to eliminate most of the present difficulty, includes widening the existing pavement and adding two traffic lanes on either side of the two summits. This widening is carried for about one-half mile each side of the southerly summit, connected through a 1,400-foot vertical curve, and on the south side of the northerly summit and approximately 1,000 feet to the north of the northerly summit connected through a 1,100-foot vertical curve. There is also a horizontal curve to the south which shortens the sight distance in that direction.

The widening is not continuous, but is stopped on either side of a timber bridge 236 feet long, at the bottom of the dip between the two summits.

The work to be done consists, in general, of constructing a graded roadbed. This work was light as in the original grading contract large slides developed, the removal of which caused the cuts to be somewhat widened, while the material was wasted in the fills which were generally wide enough for the additional widening strip. Imported borrow was placed on this graded roadbed. Portland cement concrete pavement 12 feet in width and seven inches thick was placed on each side of the existing 20-foot portland cement concrete pavement, and left a minimum of one inch above the existing pavement to allow for asphalt concrete topping to be placed on the present pavement.

The transitions at each end of the widening strips consist of portland cement base varying from two to 12 feet wide and six inches thick to be covered with asphalt concrete a minimum of one and one-half inches thick. Borders are to be plant mixed surfacing two and one-half inches thick on crusher run base one-half a foot thick.

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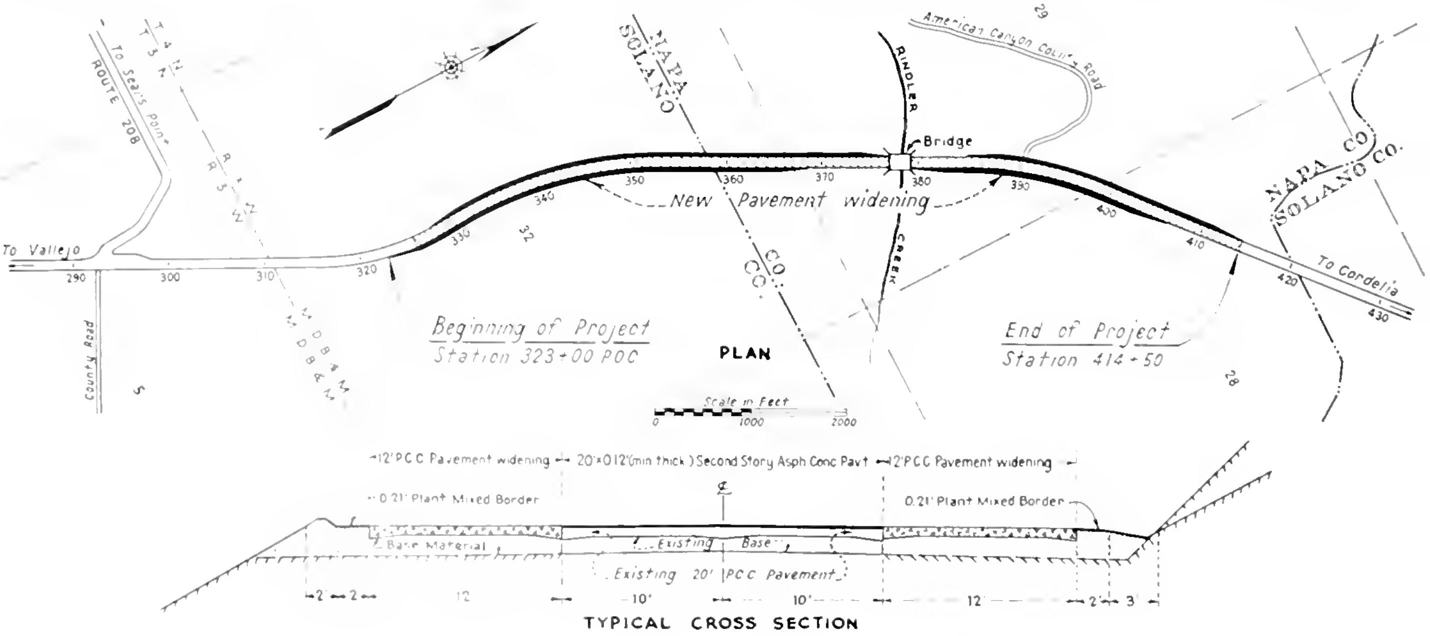

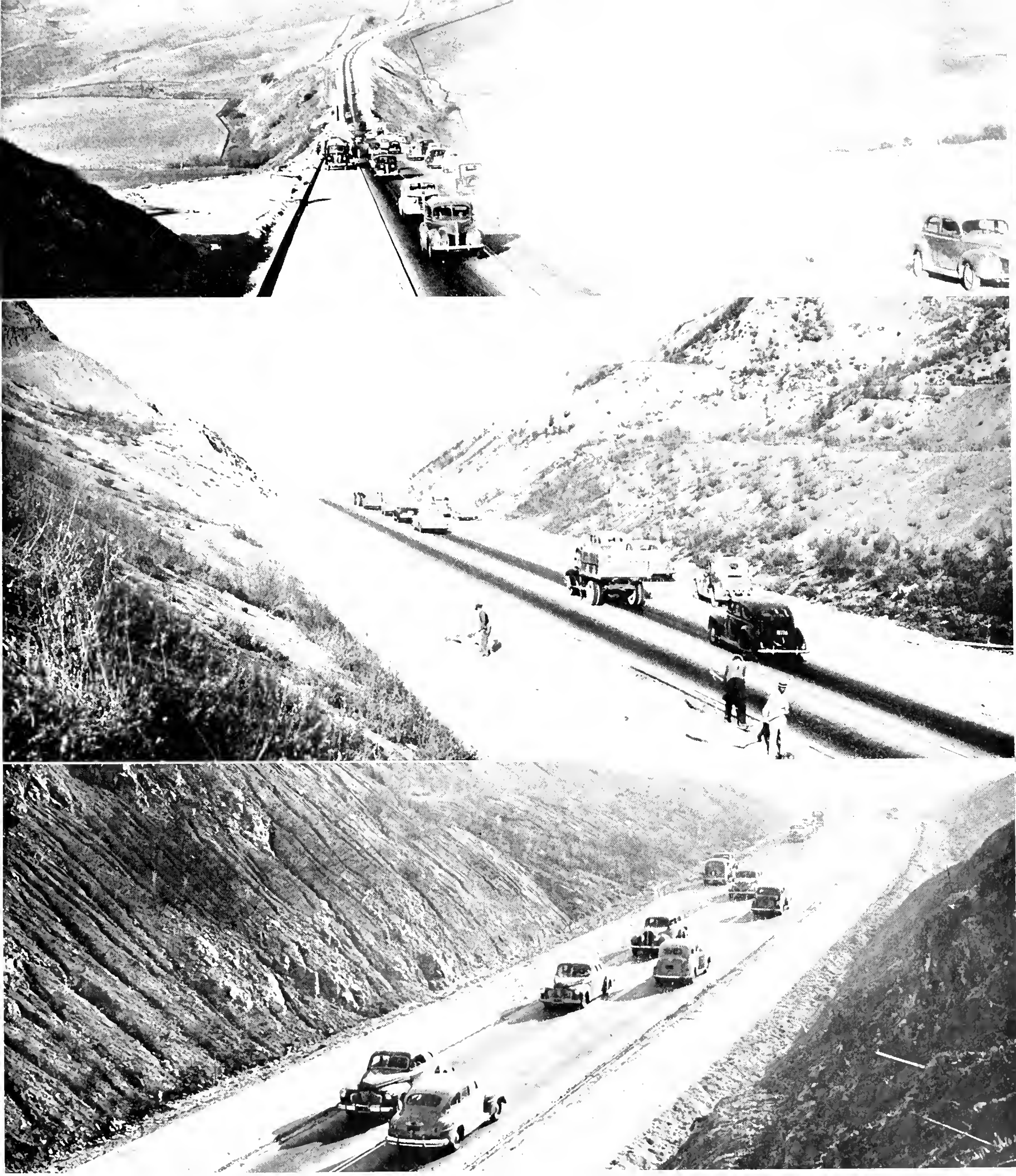

Adding extra lanes to 2-lane sections of American Canyon Cut-off (U. S. 40) to eliminate congestion on vertical curves through cuts.

View of Pit River Bridge taken just as the central span was being placed connecting up the world's highest double deck structure

Last Span of Pit River Bridge Erected

CLOSURE of steel on the central span of the great Pit River bridge, one of the major units of Central Valley Project construction, was completed on November 15th.

Steel riggers drove giant connecting pins into place, fastening the two huge cantilever arms of the bridge in the middle. The work of completing the joints on the central span of the structure, which is the highest double deck bridge in the world, was begun immediately by a crew of riveters.

Main line trains of the Southern Pacific will be routed for the first time over the new 30-mile relocation around the Shasta Reservoir probably some time in March of next year.

The State Division of Highways is rushing relocation of 15.5 miles of the Pacific Highway around Shasta Reservoir. The reconstruction of the highway is an important part of the Central Valley Project. In order to make certain improvements in standards on the realigned highway, the State is contributing approximately 10 per cent of the grading and surfacing costs and 23.5 per cent of the cost of the bridge across the Sacramento River near Antler. The Federal Government through the Bureau of Reclamation is bearing the balance of the costs.

PRECAUTION AGAINST RAIN

Urgency of National defense will not permit of winter rains delaying completion of the bridge.

To insure that inclement weather will not hamper the final work of relocating the Southern Pacific's San Francisco-Portland main line and U. S. Highway 99 around the Shasta Reservoir, the United States Bureau of Reclamation and the contractors now engaged in concreting the highway deck on the Pit River span have adopted a novel method of speeding progress of the work during the rainy season.

A giant tarpaulin, costing more than $20,000 will be purchased jointly by the bureau and the contractors and will be suspended from the bridge superstructure over the highway deck so that surfacing of the roadway deck of the bridge can proceed in spite of rain. The tarpaulin will be 300 feet long and more than 50 feet wide. It will be moved from section to section as the concreting progresses.

Working from the southern end of the bridge, Conse and Saunders, contractors, already have laid a portion of the concrete surface on the highway deck.

Financed by the Bureau of Reclamation as part of the Central Valley Project, the Pit River bridge will carry two railroad tracks on the lower deck and a four-lane section of U. S.

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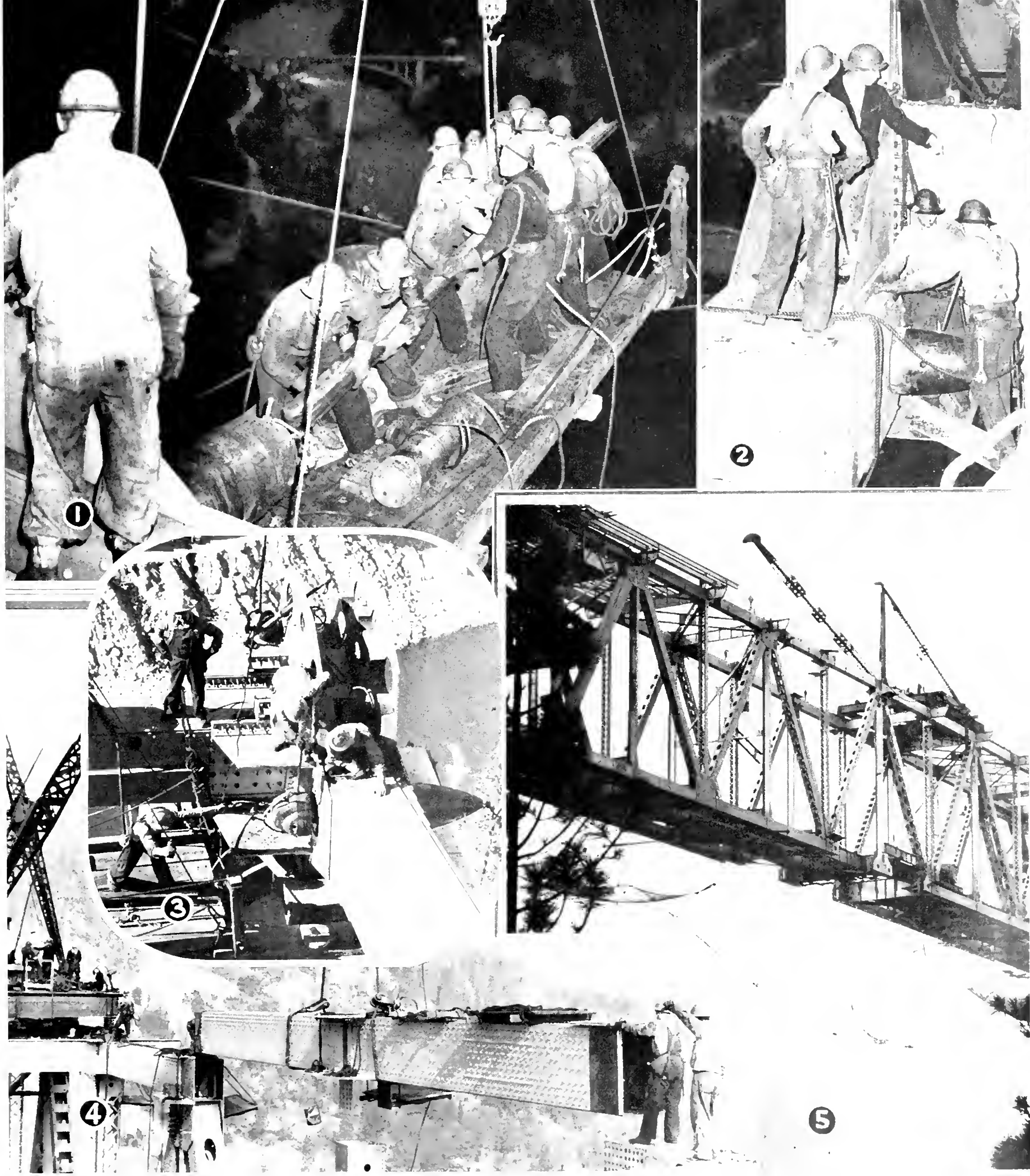


Connecting the last span: (1)—Pit River Bridge workers suspended on platform 500 feet above river ramming home 5-ton riveting pin. (2)—View of pin coming through girder. (3)—Arrow shows pin in place. (4)—Lowering connecting girder into position. (5)—Last span connection complete.

Photos by U. S. Bureau of Reclamation and Sacramento Bee

Equipment tearing up old pavement and grading for south approach to new North Sacramento Viaduct structure.

North Sacramento Viaduct Progressing With Steel and Concrete Construction

PROGRESS on the construction of the North Sacramento Viaduct across the American River overflow area between Sacramento and North Sacramento has improved considerably during the past month after having been seriously delayed for about two months due to the contractor's inability to obtain reinforcing steel.

Completion of the "On Ramp" and the subsequent placing of it in operation as a detour have permitted the contractor to resume operations at the south end of the contract where the work on the approaches and 10 bents of the structure has been held up pending the opening of the detour.

The footings and portions of the columns for the remaining 27 bents have been poured and the forming of the girders and deck has been gotten under way at the north end of the structure.

The concrete in the columns has been brought to a point sufficiently high above the ground line to reduce to a minimum the damage that might be caused by drift and silt during the approaching high water season.

The fills at the north end of the project have been completed and surfacing courses are now in the process of being placed.

While it had been the contractor's intention to complete the viaduct structure about the first of the year, the delay in the receipt of reinforcing steel has rendered the task impossible of fulfillment at that time. Taking into consideration the delay anticipated because of the overflowing of the working area during the next few months, it would appear that completion of the structure can not be looked for before next June.

Earl W. Heple of San Jose is the contractor on the work and Charles R. Poppe is resident engineer for the State.

FOR ALL-YEAR USE

The viaduct will make an all-year highway north on Route U. S. 99 and east on Route U. S. 40. The present road has been intermittently closed by high water during the winter for an average of eight days per season for the past five years. On these occasions traffic has had to be detoured over a narrow levee road, adding three miles and at least one-half hour to the trip between Sacramento and North Sacramento. During each high water period, maintenance crews have had to sandbag the highway and clean up mud and debris after the waters had subsided.

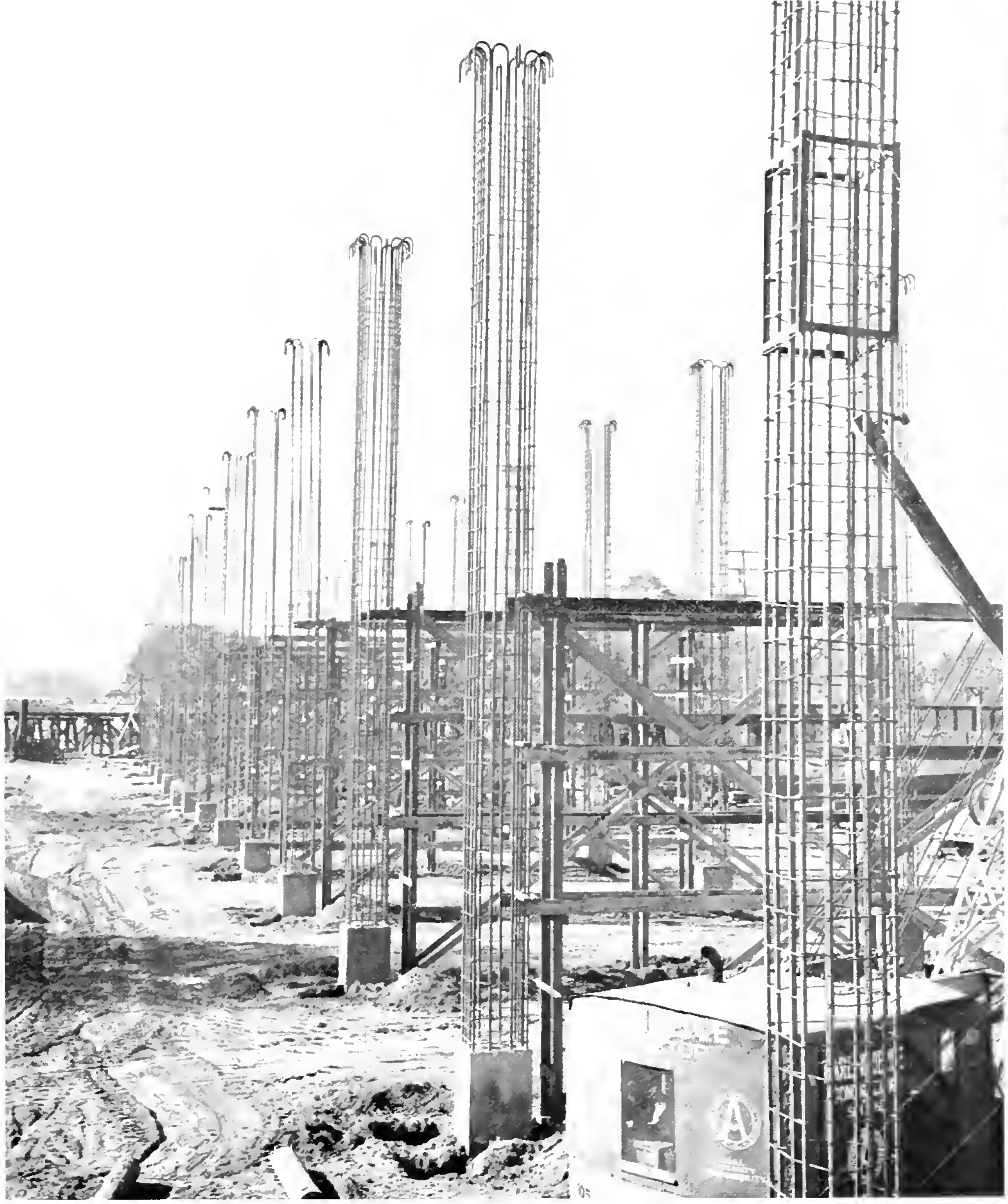
The viaduct starts about 300 feet north of the American River Bridge and rises on easy vertical curves at a maximum rate of 6.2 per cent to a height of more than 50 feet above ground. It clears the Western Pacific Railroad trestles by 28 feet, thus providing for future raising of the tracks, which are now below the stream flood plane. Connections will be made to the end of the American River bridge and at the south limits of North Sacramento.

RAMP CONNECTIONS

An off-ramp connection will be made to the Garden Highway, passing under the structure so that cars will not have to cross opposing traffic.

The viaduct will be of reinforced concrete, with the exception of the steel railing and the expansion details. It will be 1,496 feet long, consisting of 36 spans each 41 feet in length with 10-foot cantilever spans at each end. The bridge deck will have an overall width of 65 feet, consisting of a 6½ inch slab supported on 11 shallow girders each one foot wide.

The bridge will provide four traffic lanes on two 25-foot roadways, separated by a four-foot dividing strip and in addition two sidewalks each four feet wide. The bridge deck will be lighted by 20 incandescent luminaires.



Erected reinforcing steel columns mark route of viaduct across railroad trestle.

Gold Is Where You Find It Is Jury Decision

"Thar's gold in thet old shaft." On this contention, A. S. Macdonald and Milton A. Purdy, Plumas County miners, demanded $800,000 from the Division of Highways for nine acres of land required for right of way purposes on the Feather River Highway and on which is an ancient mine shaft which has not been worked for years.

The State offered the owners $1,241.85 for the property, which was refused, and the Division of Contracts and Rights of Way of the Department of Public Works was compelled to institute condemnation proceedings.

A Plumas County jury has just rendered a verdict awarding Macdonald and Purdy $380.

The defendants contended that there is still a fortune in gold in the abandoned shaft and estimated at least $800,000 could be taken out of it if it were reopened and worked.

Admitting that gold is where you find it, attorneys for the Division of Highways argued that the State of California can not pay for gold unless the gold can be seen.

On the witness stand, Purdy reduced his valuation estimate to $475,000, asking $474,550 for damages and $450 for the land. The jury awarded $360 for land and $20 for damages.

The property involved lies in Elizabethtown Ravine, between Keddie and Quincy, once the scene of extensive mining operations.

According to S. W. Elliott, Supervising Right of Way Agent of the Department of Public Works, the case was one of the most unusual ever encountered by the Division of Highways.

The jury rendered its verdict on November 27th, last.

Query—"My cutworms and beetles are better than ever before, but for some reason my potato bugs look undernourished."

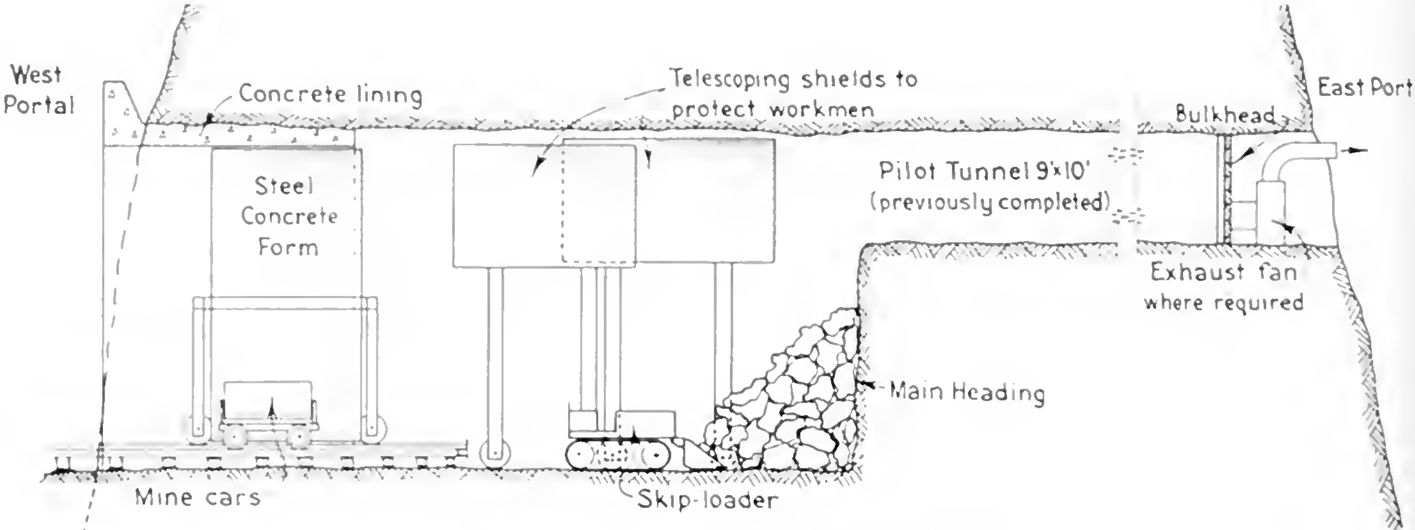
Widening Sections of American Canyon Highway

(Continued from page 10)

Providing that inclement weather does not interfere, this project should be completed and opened to traffic before Christmas, and should materially aid in the free flow of traffic over this U. S. 40, important cross-state road, extending from the San Francisco Bay area, through Sacramento and on across the continent.

The contract is being done by Heafy-Moore Company and Fredrickson & Watson Construction Company, of Oakland.

The total allotment is $141,968. A. K. Nulty is the Resident Engineer in charge for the State.



ANGELES CREST TUNNEL No 1

Boring 2 Tunnels on Angeles Crest Highway

(Continued from page 8)

From West Islip Saddle, the new highway will run along the northerly side of Mt. Islip and North Baldy Peak at elevations of from 6,500 to 7,500 feet above sea level through heavily timbered country and on very steep slopes.

Due to the ruggedness of the terrain at slightly less than 7,000 feet elevation, construction roads necessary to by-pass the tunnel sites for roadway work ahead were considered to be impractical as well as disfiguring to the landscape. Facing a "bottle-neck," it became necessary to adopt tunnel construction procedure that would expedite progress and allow passing of heavy equipment and crews through the tunnels at the earliest possible moment.

To facilitate such procedure, beginning at the westerly portal of tunnel No. 1, a small pilot drift 9 feet wide by 10 feet high, was rapidly excavated at the crown of the tunnel, this size opening being sufficient to pass air equipment and crews ahead for work on tunnel No. 2.

PILOT DRIFTS USED

Excavation was then immediately started on tunnel No. 2 with a 14 foot by 11 foot pilot drift at grade, this size being adequate for passing heavy grading equipment. Simultaneously with the start of construction of this pilot drift in tunnel No. 2, excavation of the full face of tunnel No. 1 was undertaken and both operations are, at present, under way. Upon completion of these two operations, heavy grading equipment can readily be passed through the tunnels for roadway excavation ahead.

The pilot drifts as above planned, aside from facilitating construction procedure, serve as a part of the ventilating system and also provide exploratory information necessary for proper design of tunnel lining.

In construction of the pilot drifts, forced ventilation is provided through a 10-inch duct from a 15-inch blower capable of furnishing 5,400 cubic feet of air per minute at 1,485 R.P.M., powered by a 10 H.P. gasoline engine. Ventilation during excavation of the full section of tunnel No. 1 is, under present conditions, adequately furnished by natural draft through the pilot drift. This is to be augmented as work progresses with an exhaust blower in the pilot tunnel.

Two distinct types of rock are encountered: gneiss, a faulted metamorphic rock, and pink granite, a massive igneous rock, both of which have been found to be sufficiently stable to require timbering of pilot drifts only in faulted areas and at the portals. Excellent breakage is being obtained in both types of rock with approximately 3 lbs. of 50 to 60 per cent special tunnel powder per cubic yard.

Mucking of the pilot drifts is being satisfactorily handled with a mine car air loader. Mucking of the full section is under way with half cubic yard skip-loaders.

For protection against dropping spalls from the tunnel crown during drilling and mucking of the full tunnel section (35 feet wide by 22 feet 2 inches high), two telescoping steel and timber shields, 20 feet and 30 feet long, operating on rails, are moved into place over the workmen as excavation progresses.

With steel forms for reinforced concrete tunnel lining following the protection shields closely behind excavation operations, workmen are given a maximum of protection against falling rocks.

Tunnel lining, consisting of an 18-inch reinforced concrete ring, is being successfully placed with a one-half cubic yard pneumatic concrete placer operating at 110 pounds air pressure. Concrete work noted in the photographs at the westerly portal of tunnel No. 1 is a strengthening arch ring to reinforce the portal.

Coarse aggregate for concrete is produced on the job from tunnel muck and fine aggregate is obtained from a local deposit.

Field operations are in charge of Superintendent Ben H. Henry and Resident Engineer Jim Lackey under District Engineer S. V. Cortelyou.

In Memoriam

Myrtle V. Murray

THOUSANDS of men and women who have played a part in the public life of California during the past three decades were saddened by the death on November 29th of Miss Myrtle V. Murray, Administrative Assistant to Director Frank W. Clark of the Department of Public Works.

To the headquarters staff of the department in Sacramento and to many hundreds of employees throughout the State, the passing of Miss Murray is a distinct personal loss.

Entering State service as a girl in 1911, Miss Murray viewed the passing political parade in the Capital City of California for 31 years, the while taking an ever-increasing active role in varied governmental affairs.

She was the only woman ever to hold the office of Director of Public Works in this State. In recognition of many years of faithful public service, Governor James Rolph, Jr., on October 10, 1932, following the resignation of Col. Walter E. Garrison as Director, appointed her Public Works Director so that she might have the honors and emoluments of the office pending the assumption of the post by Earl Lee Kelly on October 14th.

MYRTLE VENELIA MURRAY

Myrtle V. Murray was born in Dallas, Texas. She was one of three girls born to Dr. and Mrs. Carl L. Murray. The family moved to Los Angeles in the 90's. Following her graduation from the Los Angeles high school, Miss Murray became a resident of Chico, where her father had established himself in the practice of medicine and later became a widely known physician in northern California.

While still in her teens, Miss Murray came to Sacramento from Chico to accept a position as secretary for the firm of Wood-Curtis Co., and served in that capacity until she was appointed in 1911 a stenographer in the old State Highways Division of those days. The staff then consisted of a chief engineer, an assistant and two stenographers. Miss Murray saw that little organization expand into the present-day Department of Public Works employing some 6,000 persons.

Hiram W. Johnson was elected Governor of California in 1910 and a few months after he assumed office in January, 1911, Miss Murray was transferred by him to his office. In that year, Governor Johnson appointed Austin Bradstreet Fletcher to head the first State Highway Department and Miss Murray became his secretary.

In 1921, under Governor William D. Stephens, the Legislature created the present Department of Public Works and Mr. Fletcher became the first Director, retaining Miss Murray as his secretary. Miss Murray served in that capacity under eight Public Works directors. During the latter part of his term, Governor Stephens borrowed Miss Murray and she was a valued member of his office staff until B. B. Meek made her his secretary following his appointment as Director of Public Works by Governor C. C. Young. Following the appointment of Mr. Kelly in 1932, she became Administrative Assistant of the department, being retained in that position by Director Clark.

Miss Murray's passing has left a void in the Department of Public Works which can not be filled.

Surviving Miss Murray are her two sisters, Mrs. Clara Blood and Mary Murray, to whom goes the sympathy of the entire personnel of the department.

Detail Of Major Project Allocations In Revised Budg

Continuing the article on the budget from page two, the ensuing pages present tabulations showing the alloca State Highway System during the ninety-third and ninety-fourth fiscal years of the biennium that began July 1, 1 the amount appears in parentheses for one of the counties, indicating that the two counties share the allocation w

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
Alameda	5	Mayhew Creek		$18,500	
Alameda	5	Castro Valley to Dublin (portions)	1.5	132,300	
Alameda	5	Livermore to Hayward	18.7	35,500	
Alameda	5	Hayward to Dublin (portions)	1.1	8,000	
Alameda	69	Ashby Avenue to Bay Bridge Distribution Structure	1.7	112,200	
Alameda	69	Oak Street to High Street	3.3	1,719,900	
Alameda-Contra Costa	69	Junction with Route 14 to Ashby Avenue (see Contra Costa County)	2.8	235,800	
Alameda	107	Alameda Creek		26,500	
Alameda	107	Arroyo de Laguna		29,100	
Alameda-San Francisco	68	San Francisco-Oakland Bay Bridge (see San Francisco)		1,700,000	$2,317,800
Alpine	23	South of Markleeville		2,600	
Alpine	24	At Woody Gulch		16,000	
Alpine	24	Summit of Pacific Grade to Wolfe Creek Road (portions)		13,200	31,800
Amador	34	Pine Grove to Lower Volcano Road		33,100	
Amador	34	Antelope Springs to Cooks Station (portions)		19,800	
Amador-Calaveras	65	Across Mokelumne River (see Calaveras County)		6,600	59,500
Butte-Sutter	3	Lomo to 0.2 mile north of Butte County Line (portions) (see Sutter County)		251,400	
Butte	3	Biggs Road to Tehama County Line (portions)	3.0	27,800	
Butte	21	Feather River to West Branch	10.4	158,800	
Butte	45	At Big Butte Creek Overflow		11,900	
Butte	47	Pine Creek Overflows		55,600	
Butte	87	At Grass Draw		7,500	
Butte	87	Oroville to junction Route 3 (portions)		62,200	575,200
Calaveras	24	County Line to Valley Springs (portions)	5.0	39,700	
Calaveras	24	Angels Camp to Murphy's (portions)	2.0	26,500	
Calaveras-Amador	65	Across Mokelumne River (see Amador County)		6,600	66,200
Colusa	7	In Arbuckle		1,453.50	1,453.50
Contra Costa-Alameda	69	Junction with Route 14 to Ashby Avenue (see Alameda County)	2.8	235,800	
Contra Costa	14	Richmond to Carquinez Bridge (portions)	3.5	345,500	
Contra Costa	14	Richmond to Martinez (portions)	17.6	29,600	
Contra Costa	75	Orinda Road to Walnut Creek (portions)		309,600	
Contra Costa	106	Franklin Canyon; Martinez to Route 14 (portions)		529,200	
Contra Costa	106	Hercules to Martinez (portions)		21,200	1,235,100
Del Norte	1	At Station 817		3,300	
Del Norte	1, 71	1 mile south of Crescent City to 1.5 miles north of Crescent City (portions)	0.3	31,900	
Del Norte	46	Klamath to Klamath Glenn (portions)		19,800	55,000
El Dorado	11	2½ miles east of Clarksville to 1½ miles west El Dorado (portions)		370,500	
El Dorado	23	At Branches of Big Meadow Creek		2,600	
El Dorado	23	Across Upper Truckee River		10,000	383,100
Fresno	4	Malaga to Cherry Avenue	4.0	370,500	
Fresno	10	Lone Pine Service Station to 1.3 miles east of Parkfield Junction	1.6	92,600	
Fresno, Kings	10	Coalinga to Armona (portions) (see Kings County)		19,800	
Fresno	41	White Deer Road to Forest Boundary	3.12	24,200	
Fresno	41	Fowler Switch Canal		13,200	
Fresno	41	Kings Slough and Overflows (12 openings)		136,300	
Fresno	76	Big Dry Creek		20,000	
Fresno	76	Humphreys Creek		1,300	
Fresno	76	Home Creek		19,800	
Fresno	76	Snowslide Creek		12,000	
Fresno	76	Corrall Creek		23,800	
Fresno	76	Pitman Creek		8,000	
Fresno	76	Route 125 to Huntington Lake (portions)		26,500	
Fresno, Kings	125	Kettleman City to Fresno (portions) (see Kings County)		13,200	
Fresno-Madera	125	Fresno to 1.6 miles north San Joaquin River, Canal Bridge (see Madera County)	9.3	317,500	768,000

or Current Biennium As Adopted November 10, 1941

highway funds as revised by the State Highway Commission for each proposed major project improvement of the
ne items of proposed expenditure are grouped by counties and in cases where the projects cross county lines
only included in the total column opposite the name of the other county.

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
Glenn	7	North of Willows		$26,500	
Glenn	45	Butte City Ferry		9,500	
Glenn	45	Willows to Glenn (portions)	3.0	26,500	$62,500
Humboldt		At Bull Creek in Bull Creek State Park		7,900	
Humboldt	1	Jordan Creek to South Scotia Bridge	1.7	25,900	
Humboldt	1	Across Eureka Slough	0.6	406,700	
Humboldt	1	North Scotia Bridge to Rio Dell	1.4	128,300	
Humboldt	1	Weott to 0.6 mile north	0.6	76,000	
Humboldt	1	Sinclair's northerly (portions)	1.63	12,600	
Humboldt	1	Avenue of Giants (portions)	0.28	2,100	
Humboldt	1	South Scotia Branch to Scotia	3.16	66,800	
Humboldt	1	Loleta to Salmon Creek (portions)	5.90	29,100	
Humboldt	1	Big Lagoon northerly (portions)	2.00	13,200	
Humboldt	1	3.5 miles north of Garberville at Redway		92,600	
Humboldt	1	¼ mile north of Dyerville		92,600	
Humboldt	1	At South Fork Eel River Branch at Smith Point		23,600	
Humboldt	1	Metropolitan to Fortuna (portions)		9,900	
Humboldt	1	State Parks, various locations		6,600	
Humboldt	1	Richardson Grove (portions)		8,900	
Humboldt	1, 56	At Fernbridge Intersection and Rohnerville Curve	0.3	19,900	
Humboldt	20	Across Mad River	0.5	285,500	
Humboldt, Trinity	20	Willow Creek to Whites Bar (portions) (see Trinity County)		(271,200)	
Humboldt	20, 46	At Minor Creek, Glendale Creek and Starritt Mine Flume		5,000	1,313,200
Imperial	12	Mountain Springs to Dixieland (portions)		18,200	
Imperial	26	El Centro to Brawley and in Imperial	13.0	326,500	
Imperial	26	Trifolium Canal to 2 miles north Sandy Beach Road (portions)		390,000	
Imperial	26	Coral Wash to north County Line		91,000	
Imperial	26	Calexico to El Centro	10.0	58,500	
Imperial	27	Junction Route 12 and 26 via Adams Avenue and Fourth Street to Route 27; in El Centro, cooperative project		195,000	
Imperial	27	East Highline Canal to Yuma		32,500	
Imperial	187	Niland to north County Boundary (portions)		65,000	
Imperial	187	Bonds Corners to Holtville (portions)		10,000	
Imperial	187	Bonds Corners to Holtville (portions)		3,900	
Imperial	201	North of Calexico to east of Brawley (portions)		10,500	
Imperial	201	Brawley to Calipatria (portions)		13,000	
Imperial	202	East Highline Canal Line Changes	0.6	25,000	1,239,100
Inyo	23	Cottonwood Creek to Bartlett (portions)	2.5	84,500	
Inyo	23	At Railroad Crossing Station 528 to Station 533, Section H	0.1	2,750	
Inyo	23	South of Route 127 to Alabama Gate (portions)	1.5	9,700	
Inyo	23	Independence to Fish Springs School (portions)	6.0	19,500	
Inyo	23	Haiwee to Cottonwood Creek and Round Valley Road to Mono County Line (portions)	1.0	5,200	
Inyo	23	Drainage correction on Primary Routes		3,250	
Inyo	63	Near Deep Springs School	0.1	400	
Inyo, Mono	76	Laws Junction to Mono County Line (see Mono County)	4.6	(73,600)	
Inyo	76	Near Plant No. 3	0.05	3,600	
Inyo	127	Near Shoshone	0.1	1,300	
Inyo	127	In Death Valley National Monument		23,100	
Inyo		Various Drainage correction on Secondary Roads		600	227,500
Kern	4	Fort Tejon to 1.6 miles north of Grapevine Station; Grapevine Creek Bridge	6.2	540,000	
Kern	4	Southern Pacific Railroad Overpass to Famosa (portion); Lerdo Canal Bridges		494,000	
Kern	4	Famosa to Delano (portions)		52,000	
Kern	4	Safety Items on Primary Roads		3,250	
Kern	23	North Boundary Mojave to 6.5 miles north	6.5	140,700	
Kern	23	Cinco to Ricardo (portions)	1.3	4,000	
Kern	58	Mojave easterly (portions)	8.0	31,200	

DETAIL OF MAJOR PROJECT ALLOCATIONS IN REVISED BUDG

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
Kern	58	Marcel easterly; 5 unnamed creeks		$475,000	
Kern	58	5.6, 5.7, 5.9 miles east of Buttonwillow, Equalizers		26,000	
Kern	58	Main Drainage Canal		13,000	
Kern	58	Buena Vista Slough		41,600	
Kern	58	McKittrick to Rosedale (portions)		19,500	
Kern-Tulare	129	Deepwell Ranch to ¼ mile north of County Line (see Tulare County)	8.0	(221,000)	
Kern	138	McKittrick to Kings County Line (portions)		39,000	
Kern	142	Southern Pacific Railroad Tracks to Levee Canal	0.66	78,000	
Kern	142	Barren Creek Bridge		9,500	
Kern	142	Poso Creek Bridge		3,400	
Kern		Various Drainage correction on Secondary Roads		6,500	
Kern		Various Safety Items on Secondary Roads		3,250	$1,979,900
Kings, Fresno	10	Coalinga to Armona (portions) (see Fresno County)		(19,800)	
Kings	125	5th Standard Parallel to Stratford; Kings River Bridge	4.7	270,000	
Kings	125	Prairie Draws		1,100	
Kings, Fresno	125	Kettleman City to Fresno (portions) (see Fresno County)		13,200	
Kings	134	Corcoran to Tulare County Line (portions)		6,600	
Kings	138	North and south of Junction of Route 125	10.0	59,500	350,400
Lake	15	Laurel Dell Lake to Tule Lake (portions)	1.75	14,000	
Lake, Mendocino	16	Lakeport to Route 1 (portions) (see Mendocino County)		264,600	
Lake	49	Middletown southerly (portions)	3.9	30,700	
Lake	49	Putah Creek to Lower Lake (portions)		95,300	
Lake	89	Lakeport easterly (portions)	0.8	6,400	
Lake	89	Intersection with Route 16 southerly (portions)	0.9	7,100	
Lake	89	At Kelsey Creek	0.3	7,900	
Lake	89	At Scott Creek	0.3	2,600	428,600
Lassen	21	At Long Valley Creek		5,300	
Lassen	28	Big Valley Mountain	2.5	12,000	
Lassen, Sierra	29	Constantia to Nevada State Line (portions) (see Sierra County)		79,400	
Lassen	73	Ravendale to Termo	5.0		
Lassen	73	Brockmans to Madeline (portions)	3.5	61,700	158,400
Lassen	73	Viewland to Secret Valley (portions)	10.0		
Los Angeles	4	Paradise Ranch to Piru Creek (portions)	3.55	81,250	
Los Angeles	4	Castaic to Alamos Creek (portions)	16.0	52,000	
Los Angeles	9	Glendora to San Bernardino County Line (portions)		16,000	
Los Angeles	9	At Rosemead, traffic signals		6,500	
Los Angeles	26	Right of Way, Ramona Freeway; Los Angeles to Pomona (portions)		300,000	
Los Angeles	26	Garey Avenue to Hamilton Boulevard in Pomona (cooperative project)	0.7	45,500	
Los Angeles	26	Valley Boulevard Intersection		3,250	
Los Angeles	26	Rosemead to Potrero Street (portions)		17,000	
Los Angeles	60	Walnut Canyon to Winter Canyon (portion)		627,000	
Los Angeles	60	South City Limits to 24th Street in Hermosa Beach	1.2	96,500	
Los Angeles	60	0.4 mile east of Sunset Boulevard		19,500	
Los Angeles	61	Angelus Crest Highway		624,000	
Los Angeles	156	0.5 mile south of Topanga Post Office		2,000	
Los Angeles	158	Sepulveda Boulevard; Centinella Avenue to Jefferson Boulevard	0.7	117,000	
Los Angeles	162	Pacific Electric Railroad Tracks at Hancock Avenue		4,300	
Los Angeles	162	Santa Monica Boulevard, Fairfax to Croft	0.7	58,500	
Los Angeles	164	La Tijera to Sepulveda	1.5	16,000	
Los Angeles	164	Hawthorne Ave., El Segundo to north City Limits		18,500	
Los Angeles	166	Santa Ana Freeway (portions)		585,000	
Los Angeles	168	Rosemead Boulevard, Route 60 to Center Street	3.4	982,000	
Los Angeles	168	Rosemead Boulevard, Las Tunas Boulevard to Longden Avenue	0.7	84,500	
Los Angeles	169	Bellflower Boulevard, Compton Boulevard to Lakewood Boulevard		18,200	
Los Angeles	169	Bellflower Boulevard, Artesia Street to 800 ft. south of South Street		50,500	
Los Angeles	170	Orange County Line to 1 mile north		1,700	
Los Angeles	173	Olympic Boulevard, Los Angeles City Limits to Lincoln Boulevard in Santa Monica	2.3	560,000	
Los Angeles	174	At Los Angeles River (cooperation with U.S.E.D.)		36,400	
Los Angeles	174	Lakewood Boulevard to Orange County Line (portions)	9.82	74,100	
Los Angeles	178	Carson Street east of Lakewood Boulevard		18,200	
Los Angeles	179	Route 60 to San Gabriel River	1.4	15,600	

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
COOPERATIVE PROJECTS IN LOS ANGELES:					
Los Angeles	2	Cahuenga Pass; 900 ft. north of Barham Boulevard to 1,000 ft. north of Lankershim Boulevard		*($486,000)	
Los Angeles	2	Parkway Route 2; from Los Angeles River at Aliso Street to Vermont Avenue		3,250,000	
Los Angeles	2	Aliso Street to Soto Street (portions)		511,200	
Los Angeles	4	Daley Street; Main Street to Pasadena Avenue		*(330,000)	
Los Angeles	4	San Fernando Road; Ensign Avenue to Burbank		*(35,600)	
Los Angeles	4	San Fernando Road; Bransford Avenue to Truesdale Avenue		*(47,200)	
Los Angeles	4	San Fernando Road; Delay Drive to Verdugo Road		*(62,000)	
Los Angeles	26	Ramona Freeway; Macy Street to Indiana Street	1.95	545,000	
Los Angeles	158	Sepulveda Boulevard, Sunset Avenue to south of Waterford and Ohio Avenue to Pico Place		*(241,000)	
Los Angeles	161	Colorado Street, Townsend Avenue to Eagle Rock Boulevard		*(92,800)	
Los Angeles	161	Moorpark Street Bridges and Approaches, Tujunga Wash		*(50,000)	
Los Angeles	163	Bicknell Street to Windward Avenue (portions) (State Highway Fund $232,000; City of Los Angeles, ¼c $117,590		232,000 *(117,590)	
Los Angeles	165	Figueroa Street, Neola to Buena Vista Terrace		*(112,500)	
Los Angeles	165-205	Arroyo Seco Parkway and Figueroa Street, Avenue 22 to Figueroa Terrace		1,691,000	
Los Angeles	173	Olympic Boulevard, Berendo Street to Western Avenue		*(310,000)	
Los Angeles	173	Olympic Boulevard, Hoover Street to Menlo Avenue		*(111,000)	
Los Angeles	173	Olympic Boulevard, Bundy Drive to Centinella Avenue		88,000	
Los Angeles	173	Flower Street to west City Limits, traffic signals		*(28,000)	$10,848,200
Madera, Merced	4	½ mile north of Ash Slough to 2.6 miles north of County Boundary (see Merced County)	1.8	(221,700)	
Madera	4	San Joaquin River to Madera	7.5	33,200	
Madera	32	Califa to Merced County Line (portions)		39,700	
Madera, Fresno	125	Fresno to 1.6 miles north of San Joaquin River Bridge; Canal Bridge (see Fresno County)	9.3	317,500	
Madera	126	Across City Canal		5,700	396,100
Marin	1	Ignacio to north County Boundary (portions) Navato Creek		396,900	
Marin-Sonoma	8	Ignacio to Shellville (portions) (see Sonoma County)		4,800	401,700
Mariposa	18	8.7 miles west of El Portal		1,000	
Mariposa	65	At Maxwell Creek		3,300	
Mariposa	65	At CCC Camp	0.5	9,300	13,600
Mendocino	1	At South Fork Eel River		19,800	
Mendocino	1	¾ mile north of Red Mountain Creek to Piercy	3.9	333,400	
Mendocino	1	Hopland to Crawford Ranch; McNab Creek	6.7	487,000	
Mendocino	1	N. W.P.R.R. to Willits (portions)	0.9	104,500	
Mendocino	1	At Elk Creek		10,600	
Mendocino	1	0.5 mile south of Hopland		10,600	
Mendocino	1	At Ackerman Creek		2,600	
Mendocino	1	Ridgewood Hill (portions)	0.92	6,400	
Mendocino	1	Sherwood Road to Rattlesnake Summit (portions)	2.85	21,200	
Mendocino	1	Rosswarnes northerly (portions)	0.66	5,300	
Mendocino	15	Calpella to County Line (portions)	1.90	15,100	
Mendocino, Lake	16	Lakeport to Route 1 (portions) (see Lake County)		(264,600)	
Mendocino	48	Flynn Creek to Navarro	2.0	86,000	
Mendocino	48	Ward Creek—Mile 45.1		2,000	
Mendocino	48, 56	Fairbanks Hill and Gualala to Point Arena (portions)	5.0	29,600	
Mendocino	56	At Albion River	0.7	357,200	
Mendocino	56	Mile 2.5 northerly		700	
Mendocino	56	Salmon Creek Bridge northerly		5,300	
Mendocino	56	Mile 5.1 Dark Gulch		13,200	
Mendocino	56	Mile 6.6 south of Buckhorn Creek		9,400	1,519,900
Merced, Madera	4	¼ mile north of Ash Slough to 2.6 mile north of County Boundary (see Madera County)	2.6	221,700	
Merced	32	West County Boundary to Foot of Grade and San Luis Creek Line Change	4±	311,000	
Merced	41	Dos Palos Wye to Dos Palos (portions)	4.0	26,500	

* City of Los Angeles ¼ cent State Highway Funds; amounts not included in County total of State Highway Funds.

DETAIL OF MAJOR PROJECT ALLOCATIONS IN REVISED BUDG

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
Merced	32	Pacheco Pass to Junction Route 121 (portions)	1 5		
Merced	41	Centinella to Los Banos (portions)	10 8	$86,000	
Merced, Stanislaus	41	Vernalis to Junction Route 32 (portions) (see Stanislaus County)	5 0		
Merced	121	Centinella to Junction Route 32	3 0	19,800	
Merced	122	West of Merced (portions)	4 0	9,900	
Merced	123	Junction Route 32 to Merced River (portions)	3 5	26,500	$701,400
Modoc	28	Pit River to Canby (portions)	6 0	6,700	
Modoc	28	Lakeview Junction to Toms Creek (portions)	8 2	15,300	
Modoc	28	Toms Creek to Cedarville (portions)	10 0	12,800	
Modoc	73	Likely northerly	1 0	14,200	
Modoc	73	At Toms Creek, Joseph Creek, Dry Gulch and New Pine Creek		38,000	
Modoc	73	Likely to Alturas (portions)	18 6	94,600	181,600
Mono	13	Vicinity Mile 4.6, Section A		6,500	
Mono	23	Rock Creek to Casa Diablo (portions)	8 0	166,300	
Mono	23	1 mile north of Bridgeport to Dresslers Corner	1 2	27,300	
Mono	23	Vicinity Mile 12.55 and Mile 14.55, Section J	2 0	18,000	
Mono	23	Station 381, Section J	0 1	1,000	
Mono	23	Station 114 to 194, Section I	0 1	2,300	
Mono	23	Station 543 + 50 to Station 547 + 00, Section K	0 1	3,700	
Mono	23	Station 610, Section I		250	
Mono	23	In Leevining		900	
Mono	23	Vicinity Chris' Flat	0 1	4,500	
Mono	23	In Bridgeport		1,500	
Mono	23	Casa Diablo Hot Springs to Crestview (portions)	2 7	22,750	
Mono	23	Conway Summit to Bridgeport (portions)	6 0	20,500	
Mono	23	Crestview to June Lake Junction	9 7	34,300	
Mono	23	Near Point Ranch		700	
Mono	40	West Boundary to Route 23 (portions)		31,900	
Mono	40	Route 23 to Gas Pipe Springs (portions)	14 3	19,500	
Mono	76	Near Hammil Station	1 0	7,800	
Mono, Inyo	76	Laws Junction to Mono County Line (see Inyo County)	4 6	(73,600)	
Mono	95	Near Winemuller's, Mile 8.5, Section A	0 4	10,200	
Mono	95	Antelope Valley to State Line (portions)	2 0	5,500	
Mono	111	Grant Lake to Route 23	2 6	52,000	
Mono	111	Station 76 to Station 111 + 25, Section A	0 6	2,600	
Mono	111	Vicinity of Gull Lake		2,600	442,600
Monterey	2	Salinas to Santa Rita	3 1	390,000	
Monterey	2	Salinas to 2 miles south of Salinas	1 8	264,600	
Monterey	2	King City to Soledad (portions)		29,000	
Monterey, San Benito	2	Santa Rita Mesa to Chittenden Road (portions) (see San Benito County)		(396,900)	
Monterey	2	Bradley to San Ardo (portions)		4,000	
Monterey	2	San Ardo to San Lucas (portions)		33,000	
Monterey	2	At Monterey Trestles	0 22	2,600	
Monterey	2	San Lucas to King City (portions)	3 5	66,200	
Monterey	2	King City to Greenfield (portions)	2 5	52,900	
Monterey	2	Greenfield to Camphora (portions)	1 0	18,800	
Monterey	2	San Ardo to King City (portions)		19,800	
Monterey	56	Seaside to Castroville		132,300	
Monterey	56	At Salmon Creek		15,900	
Monterey	56	Near Seaside		3,400	
Monterey	56	At Villa, Alder, Willow, Kirk and Lime Creeks and Hot Springs Canyon		3,400	
Monterey	117	Monterey to Salinas (portions)		2,100	
Monterey	118	Castroville to Salinas (portions)		5,800	1,043,800
Napa, Solano	7	Junction of Route 208 to 2½ miles easterly (portion) (see Solano County)	2 5	188,700	
Napa, Sonoma	8	Ignacio to Napa (portions) (see Sonoma County)		40,400	229,100
Nevada	15	Bear Valley Grade (portions)		13,200	
Nevada-Placer	17	Auburn to Rattlesnake Creek (portions) (see Placer County)		(82,300)	
Nevada	17	1.5 miles north Rattlesnake Creek to Grass Valley	4 2	284,400	
Nevada, Yuba	25	Nevada City to Sierra County Line (portions) (see Yuba County)		(132,300)	
Nevada	37	Donner Summit to Donner Lake	2 2	79,500	
Nevada, Sierra	38	1 mile north Farad to 0.7 mile south State Line (see Sierra County)	3 0	(211,700)	377,100

OR CONSTRUCTION OF HIGHWAYS IN THE CURRENT BIENNIUM

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
Orange	2	At Doheny Park		$1,400	
Orange	2	Right of Way; Santa Ana Freeway (portions)		260,000	
Orange	43	Santa Ana Canyon Road, Peralto to Olive Cutoff	4.5	247,100	
Orange	43	Santa Ana Canyon Road, Santiago Creek Bridge to north City Limits of Orange (cooperative project)	1.4	26,000	
Orange	170	Katella Avenue to Cerritos		1,400	
Orange	174	Los Angeles County Line to Anaheim	2.85	22,100	
Orange	174	Right of Way; Santa Ana Freeway (portions)		130,000	
Orange	175	Santa Ana River Bridge		30,696.50	
Orange	176	Route 62 to Route 2 (portions)		4,000.00	
Orange	182	Orange to Orange County Park (portions)		1,400	
Orange	184	Newport Boulevard to Santa Ana	1.3	15,000	
Orange	185	1.2 mile south of Route 2 to Route 2	1.2	4,750	$743,846.50
Placer-Nevada	17	Auburn to Rattlesnake Creek (portions) (see Nevada County)		82,300	
Placer	3	Lincoln to Yuba County Line (portions)	2.0	18,500	
Placer	37	2d crossing Nevada County Line to 3d crossing Nevada County Line (portions) and Gold Run to Nevada County Line (portions)	3.0	34,400	
Placer	38	El Dorado County Line to Nevada County Line (portions)		14,200	149,400
Plumas	21	In Quincy	0.5	6,000	
Plumas	21	Spanish Creek to Quincy		6,600	
Plumas	21	North Fork to Keddie	21.0	202,800	
Plumas	21	Near Quincy		700	
Plumas	21	Beckwourth to Edes Ranch	9.3	62,700	
Plumas	21	Quincy to Western Pacific Subway	4.1	162,500	
Plumas	21	Feather River Inn to Beckwourth (portions)	16.0	6,600	
Plumas	21	Spring Garden to Feather River Inn (portions)	10.0	6,600	
Plumas	21	Spring Garden to Feather River Inn (portions)	12.0	13,200	
Plumas	21	Keddie to Spanish Creek	5.65	19,800	
Plumas	29	Lost Creek to Route 83	3.0	7,900	
Plumas	83	Greenville to Crescent Mills	4.1	25,500	
Plumas	83	Wolf Creek to Westwood Road	5.0	7,000	
Plumas	83	Crescent Mills to Greenville	4.0	5,400	533,300
Riverside	19	Mira Loma to 3 miles west of Riverside	5.6	458,000	
Riverside	64	Near Mile 10.5, Section M		2,500	
Riverside	64	State Line to 4 miles west of Blythe (portions)		65,000	
Riverside	64	Route 26 to State Line		325,000	
Riverside	64	Indio to junction Route 64-B (portions)		19,500	
Riverside	64	Perris easterly and Hemet easterly		8,000	
Riverside	64	All American Canal Station 428		26,000	
Riverside	77	Murrieta southerly (portions)		5,500	
Riverside, San Bernardino	77	Route 43 to 1 mile south of State Game Farm (see San Bernardino County)		65,000	
Riverside	78	Perris northerly		3,300	
Riverside	78	Elsinore northerly (portions)		1,000	
Riverside	146	Ripley to junction Route 64 (portions)		10,500	
Riverside	146	Route 64 to north County Line (portions)		13,000	
Riverside	187	Between Coachella and Mecca (portions)		500	
Riverside, San Bernardino	193	Corona to Route 19 (portions) (see San Bernardino County)	5.=	52,000	
Riverside	194	San Jacinto northerly (portions)		1,800	
Sacramento	3	American River Bridge to North Sacramento	0.7	744,500	
Sacramento	4	Cosumnes River and Overflows		26,600	
Sacramento	4	San Joaquin County Line to Sacramento (portions)		18,500	
Sacramento	11	Sacramento River Bridge at Isleton and Steamboat Slough		34,400	824,000
San Benito, Monterey	2	Santa Rita Mesa to Chittenden Road (portions) (see Monterey County)		396,900	
San Benito	119	At Oat Creek and near Stump Creek		10,000	406,900
San Bernardino	9, 26, 190	One mile west of Etiwanda Avenue (Cooperative Drainage Improvement)		105,500	
San Bernardino	9	Cherry Avenue to San Bernardino (portion)		174,500	
San Bernardino	9	Foothill Boulevard at Station 247, Section A	0.1	3,000	
San Bernardino	26	Redlands to Calimesa (portions)		195,000	
San Bernardino	26	State Street to 0.4 mile south of City Rreservoir in Redlands	1.7	253,600	
San Bernardino	26	Mission Storm Drain		13,000	

DETAIL OF MAJOR PROJECT ALLOCATIONS IN REVISED BUDG

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
San Bernardino	26	Intersections Monte Vista Avenue and Vernon Street		$2,500	
San Bernardino	31	Cajon Pass at Blue Cut Slide, Mile 5.1, Section B		1,500	
San Bernardino	31	Cajon Pass near Keenbrook, Mile 4.0, Section B		1,000	
San Bernardino	31	Cajon Boulevard at Cable Creek Overflow, Mile 2.5, Section A		800	
San Bernardino	31	Drainage correction; Victorville to Barstow (portions)		2,500	
San Bernardino	43	Victorville to 1 mile east	1 0	116,000	
San Bernardino	43	Near Arrowbear Park		500	
San Bernardino	43	San Bernardino to Route 189 (portions)		9,000	
San Bernardino	43	Running Springs Park to Big Bear Dam (portions)		3,300	
San Bernardino	58	Needles southerly		26,000	
San Bernardino	59	Deer Lodge Park to Mojave Desert	5 ±	3,250	
San Bernardino	59	At Sheep Creek		650	
San Bernardino	59	Cedar Glen Road to Route 43 (portions)		650	
San Bernardino, Riverside	77	Route 43 to 1 mile south of State Game Farm (see Riverside County)		(65,000)	
San Bernardino	189	Squirrel Inn to Lake Arrowhead (portions)		6,500	
San Bernardino	189	Route 43 to Route 59 (portions)		1,300	
San Bernardino	190	Igo to Camp Angeles (portions)		13,000	
San Bernardino	190	San Bernardino to Forest Boundary (portions)		17,800	
San Bernardino	191	At north City Limits of San Bernardino		1,500	
San Bernardino	192	Route 77 to Ontario	5 85	39,000	
San Bernardino, Riverside	193	Corona to Route 19 (portions) (see Riverside County)	5 ±	52,000	
San Bernardino	207	Junction Route 43		650	$1,044,000
San Diego	2	Torrey Pines Mesa to Del Mar Overhead	3 3	248,500	
San Diego	2	In San Diego; Market Street to Mission Bay (portions)		218,000	
San Diego	2	Wisconsin Street to 8th Street in Oceanside (cooperative project)	1 0	70,200	
San Diego	2	San Ysidro to National City (portions)		7,800	
San Diego	2	Oceanside to Las Flores (portions)		2,500	
San Diego	12	In San Diego, Barnett Avenue, Route 2 westerly		16,300	
San Diego	12	El Cajon to Casbere Ranch (portions)		13,000	
San Diego	12	Casbere Ranch to Tecate Divide (portions)		3,300	
San Diego	77	Ash Street, San Diego, to 1/2 mile north of City Limits (Cooperative Project)	7 2	585,300	
San Diego	77	Escondido to San Luis Rey River (portions)		624,300	
San Diego	77	Between Vista and Bonsall		11,700	
San Diego	77	At San Luis Rey River		22,100	
San Diego	77	Vista to north County Line (portions)		9,800	
San Diego	78	At Canada Verde		13,000	
San Diego	78	At Descanso Creek and Samagatuma Creek		13,000	
San Diego	78	At Coleman Creek		2,500	
San Diego	78	At Acorn Creek Bridge		9,750	
San Diego	78	At Matagual Valley Creek		23,400	
San Diego	78	Cuyamaca to Julian (portions)		10,400	
San Diego	195	At West and East Channels of Live Oak Creek		20,800	
San Diego	195	At Fry Creek		9,750	
San Diego	195	Pump House Line Change		16,900	
San Diego	195	Bonsall to Pala (portions)		1,300	
San Diego	195	Oceanside to Junction Route 77 (portions)		7,800	
San Diego	196	Carlsbad to Vista (portions)		3,300	
San Diego	198	San Vicente Line Change		97,500	
San Diego	198	At Sycamore Creek		12,500	
San Diego	198	At Wright Street Creek in El Cajon		26,000	
San Diego	198	Ramona to Santa Ysabel (portions)		6,500	
San Diego	198	El Cajon to San Vicente Creek (portions)		3,300	
San Diego	198	Scissors Crossing to east County Line (portions)		4,000	
San Diego		At Borego State Park		2,000	
San Diego		At Cuyamaca State Park		700	2,117,200
San Francisco, Alameda	68	Administration, maintenance, operation and insurance on San Francisco-Oakland Bay Bridge (see Alameda County)		1,700,000	1,700,000
San Joaquin	4	At Jahant Corner		3,300	
San Joaquin	53	Lodi Lake to Railroad Crossing	1 0	4,600	
San Joaquin	75	At Morman Slough and Lone Oak Creek		1,300	
San Joaquin	75	At Hunter Creek		1,600	
San Joaquin	75	At Old and Middle Rivers		26,500	
San Joaquin	97	At Calaveras River		1,300	38,600

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
San Luis Obispo	2	Line Change north of Motel	0 4	$44,200	
San Luis Obispo	2	San Luis Obispo to Santa Margarita portions		7,300	
San Luis Obispo	33	At Santa Rosa Creek		11,700	
San Luis Obispo	33	Paso Robles to Kern County Line portions		41,400	
San Luis Obispo	56	Guadalupe to Oceano portions		6,200	
San Luis Obispo-Santa Barbara	57	Seven cattle passes see Santa Barbara County		23,500	
San Luis Obispo	57	Route 2 to Cuyama River portions		13,000	
San Luis Obispo	58	At Trout Creek		33,800	
San Luis Obispo	125	Salinas River Bridge		26,000	$207,100
San Mateo	2	South County Boundary to Charter Street in Redwood City	3 22	946,000	
San Mateo-Santa Cruz	56	Santa Cruz to Tunitas portions Cooperative Project with Joint Highway District 9 see Santa Cruz County		158,800	
San Mateo	68	Redwood City to San Mateo portions		8,600	
San Mateo	68	Peninsular Avenue, San Mateo, to South San Francisco Underpass	6 64	3,043,000	3,997,600
Santa Barbara	2	Hollister Wye to San Jose Creek	3 5	553,000	
Santa Barbara	2	Las Varas Creek to ½ mile east of El Capitan Creek	3 0	377,500	
Santa Barbara	2	Right of Way; Santa Barbara Freeway Park Place to west City Limits Cooperative Project		390,000	
Santa Barbara	2	Right of Way: West City Limits to Hollister Wye Cooperative Project	2 0	13,000	
Santa Barbara	2	Zaca to Los Alamos portions		3,000	
Santa Barbara	2	Alcatraz to Las Cruces portions		7,200	
Santa Barbara	2	Goleta to Stoney Creek portions		3,700	
Santa Barbara	2	Nojoqui Summit to Buellton		7,000	
Santa Barbara	56	Orcutt to Guadalupe portions		5,200	
Santa Barbara	56	Las Cruces to Lompoc portions		28,600	
Santa Barbara	57	At Wasioja Creek		9,100	
Santa Barbara-San Luis Obispo	57	Seven cattle passes see San Luis Obispo County		23,500	
Santa Barbara	57	At Cottonwood Creek		9,100	
Santa Barbara	57	At Cuyama River		7,800	
Santa Barbara	80	At San Jose Creek		2,000	
Santa Barbara	149	At Alamo Pintado		19,500	
Santa Barbara	149	Surf to Lompoc portions		14,300	
Santa Barbara	149	1.9 miles east of Lompoc		3,500	1,453,500
Santa Clara	2	Ford Road to San Jose	8 2	595,500	
Santa Clara	5	Bascom Avenue to Park Avenue Cooperative Project	1 2	209,000	
Santa Clara	32	San Felipe to Bells Station portions		13,300	817,800
Santa Cruz	32, 56	Watsonville to Rob Roy	7 74	563,600	
Santa Cruz	42	Sempervirens Creek		23,900	
Santa Cruz-San Mateo	56	Santa Cruz to Tunitas portions Cooperative Project with Joint Highway District 9 see San Mateo County		158,800	746,300
Shasta	3	At Cottonwood Hill		4,200	
Shasta	3	Spring Creek to Redding Subway	7 0	421,400	
Shasta	3	Redding to 2½ miles north	2 5	107,200	
Shasta	3	La Moine to Siskiyou County Line portions	18 5	6,600	
Shasta	3	Redding Underpass to Hill Street		3,500	
Shasta	28	In Burney Valley portions		3,300	
Shasta	28	Redding to Diddy Hill portions		26,500	
Shasta	209	Summit City to Route 3	2 9	2,000	574,700
Sierra-Lassen	29	Constantia to Nevada State Line portions see Lassen County		79,400	
Sierra-Nevada	38	One mile north Farad to 0.7 mile south State Line see Nevada County	3 0	211,700	211,700
Siskiyou	3	North Approach in Dunsmuir, Cooperative Project		46,300	
Siskiyou	3	Siskiyou County Line to Dunsmuir	1 5	2,000	
Siskiyou	3	Gazelle to Yreka portions	17 0	10,000	
Siskiyou	46	Across Salmon River		49,000	
Siskiyou	46	At Irving, Stanshaw and Sandy Bar Creeks		38,800	
Siskiyou	46	Hamburg to Klamath River Bridge at Walker and at Walker Creek 8 miles west of Hamburg		99,000	
Siskiyou	72	Edgewood Road to Whitney Creek portions		112,500	
Siskiyou	72	Near Macdoel to Dorris portions	10 0	11,900	

DETAIL OF MAJOR PROJECT ALLOCATIONS IN REVISED BUDG

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
Siskiyou	72	Four miles north of Weed to Grass Lake (portions)	19 0	$11,900	
Siskiyou	82	Fort Jones to Route 3 (portions)	16 0	6,600	
Siskiyou	82	Yreka to Montague (portions)	6 0	4,000	
Siskiyou	83	Route 3 to McCloud (portions)	9 0	4,000	$396,000
Solano	7	North of Vacaville to 2 miles north of Power Station	6 0	487,000	
Solano-Yolo	7, 6	1.3 miles north of Dixon to Yolo Causeway (see Yolo County)		934,800	
Solano-Napa	7	Junction Route 208 to 2½ miles easterly (portions) (see Napa County)	2 5	(188,700)	
Solano	7	Fairfield to 1 mile north of Vacaville (portions)	5 1	33,100	
Solano	53	Suisun to Denverton (portions)	4 0	26,500	
Solano	90	Route 7 near Richfield Station northerly		211,700	
Solano	99	Minor Slough Bridge to Yolo County Line		12,000	
Solano	208	At Napa River		158,800	
Solano-Sonoma	208	Installment payment and interest Sears Point Toll Road (see Sonoma County)		36,400	1,900,300
Sonoma	1	Sebastopol Avenue to 9th Street in Santa Rosa		166,800	
Sonoma-Napa	8	Ignacio to Napa (portions) (see Napa County)		(40,400)	
Sonoma-Marin	8	Ignacio to Shellville (portions) (see Marin County)		(4,800)	
Sonoma	51	Beltane to Sonoma (portions)		21,000	
Sonoma	56	Timber Cove Tunnel		5,300	
Sonoma	104	Jenner to Guerneville (portions)		21,200	
Sonoma	208	Junction Route 8 to Solano County Line	2 2	21,200	
Sonoma-Solano	208	Installment payment and interest Sears Point Toll Road (see Solano County)		(36,400)	235,500
Stanislaus-Merced	41	Vernalis to Junction Route 32 (portions) (see Merced County)	5 0	(30,000)	
Stanislaus	109	Modesto to Junction Route 13	4 0	66,200	66,200
Sutter-Butte	3	Lomo to 0.2 mile north of Butte County Line (portions) (see Butte County)		(251,400)	
Sutter-Yuba	3	Feather River Bridge Foundations (see Yuba County)	1 9	416,700	
Sutter	15	Sacramento River Bridge at Meridian		46,400	
Sutter	15	Meridian Overhead		4,000	467,100
Tehama	3	1.5 mile south of Red Bluff		1,300	
Tehama	7	At Thomes Creek Bridge		14,600	
Tehama	7	South Boundary to Proberta	19 5	33,100	
Tehama	29	Paynes Creek to Lost Creek (portions)	3 0	7,900	56,900
Trinity	20	Weaverville to Whites Bar Creek (portions)		145,500	
Trinity	20	Prairie Creek to Valdor (portions)	15 0	21,500	
Trinity	20	Tom Long Gulch to East Boundary (portions)	10 7	6,600	
Trinity	20	Douglas City to Vitzhums (portions)	1 0	5,300	
Trinity	29	At Hayfork Creek		1,500	
Trinity-Humboldt	20	Willow Creek to Whites Bar (portions) (see Humboldt County)		271,200	
Trinity	35	Browns Creek		6,600	458,200

General items for northern counties which have been budgeted total $778,700.

Amounts allocated in seven northern highway districts are as follows:

District I—For culverts and State park road improvements on secondary highways, $11,800.

District II—For safety items, improving drainage and State park road improvements on secondary roads, $10,500; and for safety items and drainage improvements on primary highways, $11,900.

District III—Safety items on primary highways, $5,300; and for safety items, guard rail installations and State park road improvements on secondary highways, $12,200.

District IV—For drainage correction and intersection and safety items on primary highways, $87,200; and for drainage correction, various safety items and State park road improvements on secondary highways, $31,700.

District V—For safety items on primary roads, $7,300; and for safety items and State park road improvements on secondary roads, $12,800.

District VI—For various safety items on primary highways $6,600 and for drainage correction and safety items on secondary roads, $13,200.

District X—For drainage correction and safety items on primary roads, $9,300; and for safety items and drainage correction on secondary highways, $9,600.

Other budget items for use in all northern highway districts as needed are $41,000 for landscaping and road-

OR CONSTRUCTION OF HIGHWAYS IN THE CURRENT BIENNIUM

County	Route	Location	Mileage	Proposed expenditure for construction, right of way, engineering and contingencies	County total
Tulare	4	Tulare to Kings River (portions)		$52,000	
Tulare	4	Quail to Tipton Crossing	5 6	19,500	
Tulare	4-10	Safety Items		3,400	
Tulare	10	Right of Way; Route 4 to Mill Creek (cooperative project)	4 2	19,500	
Tulare-Kern	129	Deepwell Ranch to ¼ mile north of County Line (see Kern County)	8 0	221,000	
Tulare	129	Daley's Corner to Woodlake (portions); (Yokohl Creek Bridge)		65,000	
Tulare	132	Route 134 to Visalia (portions)	8 1	182,000	
Tulare		Various Drainage correction on Secondary Roads		6,500	
Tulare		Various Safety Items on Secondary Roads		3,500	$572,400
Tuolumne	13	2½ miles north of Keystone to south of Jamestown	7 5	99,200	99,200
Ventura	2	At Seacliff Sea Wall	0 4	169,000	
Ventura	2	Junctions Route 60 and Route 9; and El Rio to Montalvo	1 7	98,000	
Ventura	2	Mandos Curve to Pitas Point	1 5	121,600	
Ventura	2	Drainage protection Montalvo to Ventura (portions)		26,000	
Ventura	2	On Meta Street in Ventura, cooperative drainage improvement		2,500	
Ventura	9	Route 2 to Los Angeles County Line (portions)		6,500	
Ventura	9	Saticoy to Santa Clara Avenue (portions)		18,200	
Ventura	9	From Route 2 to Saticoy		11,700	
Ventura	60	Point Mugu to Little Sycamore Creek		195,000	
Ventura	60	Fifth Street to 6th Street in Oxnard		41,500	
Ventura	79	Through Santa Paula (cooperative project)	2 4	40,300	
Ventura	79	Sespe River Bridge		2,000	
Ventura	79	Santa Clara River Protection		71,500	
Ventura	79	At Pole Creek in Fillmore (cooperative project)		17,000	
Ventura	79	At intersection with Route 2		6,500	
Ventura	138	At Jim Creek		6,500	
Ventura	138	Ventura Avenue in Ventura, cooperative drainage improvement		6,500	
Ventura	154	El Rio to Route 9 (portions)	3 6	6,700	
Ventura	155	Triumpho Creek Bridge		2,500	849,500
Yolo, Solano	6, 7	1.3 miles north of Dixon to Yolo Causeway (see Solano County)		(934,800)	
Yolo	6	2½ miles east of Yolo Causeway to Washington Subway	1 3	84,700	
Yolo	50	¾ mile south to ⅓ mile north of Rumsey	1 2	43,700	
Yolo	50	Woodland to Kiesel (portions)	4 5	33,100	
Yolo	50, 90	Portions in Vicinity of Madison		10,000	
Yolo	87	0.2 mile south to 0.5 mile north of Cache Creek	0 7	33,000	
Yolo	99	Solano County Line to Irrigation Canal (portions)		17,200	
Yolo	99	Irrigation Canal to Route 6 (portions)		26,500	248,200
Yuba-Sutter	3	Feather River Bridge Foundations (see Sutter County)		(416,700)	
Yuba-Nevada	25	Nevada City to Sierra County Line (portions) (see Nevada County)		132,300	132,300

side improvements on primary roads and $32,000 for landscaping improvement on secondary highways. A total of $476,300 was budgeted for use in all northern districts for emergency construction, repair or replacement of bridges failed and posted for less than legal loads on secondary highways.

General items for southern counties total $413,600 as follows:

District V—Various safety items on primary roads, $6,500; and for safety items and State park road improvements on secondary highways, $13,400.

District VII—For safety items and small betterment projects on primary highways, $32,500; and for small grading, surfacing and drainage projects, safety items and State park road improvements on secondary roads, $48,900.

District IX—For safety items on primary roads, $3,300; and for safety items on secondary roads, $600.

District XI—For safety items on primary highways, $9,800; and for safety items on secondary roads, $12,400.

Budget appropriations for landscaping and roadside improvement projects in all southern districts totaling $75,500 for primary and $28,600 for secondary highways were provided.

The Budget provides for $182,100 for emergency construction, repair or replacement of bridges failed and posted for less than legal roads on secondary roads in all southern districts.

Bids and Awards for November, 1941

KERN TULARE COUNTIES Between Deepwell Ranch and ½ mile north of Kern-Tulare County Line, about 8.0 miles, to be graded and penetration treatment applied. District VI, Route 129, Sections B.A. N. M. Ball Sons, Berkeley, $135,632; Griffith Co., Los Angeles, $137,312; A. Teichert & Son, Inc., Sacramento, $138,083; M. J. Ruddy, Modesto, $145,203; Macco Construction Co., Clearwater, $145,376; Rexroth & Rexroth, Bakersfield, $153,413; Rhoades Bros., Los Angeles, $157,049; Claude C. Wood, Lodi, $157,796; Harms Bros., Sacramento, $162,165; Olaf Nelson Construction Co., Logan, Utah, $159,355; Clyde W. Wood, Los Angeles, $165,602; M. J. B. Construction Co., Stockton, $167,167; Oberg Bros. & Nathan A. Moore, Los Angeles, $172,292; T. M. Page, Glendale, $177,111; A. S. Vinnell Co., Alhambra, $182,730; Dimmitt and Taylor, Los Angeles, $190,972. Contract awarded to Louis Biasotti & Son, Stockton, $131,718.

LOS ANGELES COUNTY — Between Long Beach Traffic Circle and Carson Street, about 3.0 miles to be graded and paved with asphalt concrete on Portland cement concrete base. District VII, Route 168, Sections A,Long Beach. Oswald Bros., Los Angeles, $265,061; Sully-Miller Contracting Co., Long Beach, $274,081; Griffith Co., Los Angeles, $276,989; Ansco Construction Co., Inc., Long Beach, $285,163. Contract awarded to J. E. Haddock, Ltd., Pasadena, $259,821.

MONTEREY COUNTY Between King City and Greenfield (portions) about 2.5 miles, plant mixed surfacing to be furnished and delivered to State spreader boxes on the road. District V, Route 2, Section E. Hayward Building Material Co., Hayward, $17,050. Contract awarded to Walter J. Wilkinson & H. B. Scott, Watsonville, $15,125.

SAN DIEGO COUNTY In the City of San Diego, on Pacific Highway between Bean Street and Smith Street and on Barnett Avenue from Pacific Highway to ½ mile westerly, a distance of about 1.6 miles, drainage system to be constructed. District XI, Routes 2, 12. R. E. Hazard & Sons, San Diego, $41,604; V. R. Dennis Construction, San Diego, $48,385. Contract awarded to Walter H. Barber, San Diego, $41,291.

SAN FRANCISCO COUNTY—Existing drain from Mountain Lake to be extended approximately 2200 feet to a connection with an existing city storm drain. District IV, Route 56. Fay Improvement Co., San Francisco, $5,431; E. J. Treacy, San Francisco, $5,664; M. J. Lynch, San Francisco, $6,165; Eaton & Smith, San Francisco, $6,625; Chas. L. Harney, San Rafael, $7,770; Edwin J. Tobin, Oakland, $8,372; Lowrie Paving Co., Inc., San Francisco, $9,345. Contract awarded to M. J. Mequire & M. Hester, Oakland, $4,638.

SAN MATEO COUNTY Between Charter St. in Redwood City and San Francisquito Creek Bridge, about 3.2 miles to be graded and paved with asphalt concrete. District IV, Route 2. Piazza and Huntley, San Jose, $363,686; A. J. Raisch and Earl W. Heple, San Jose, $364,188. Contract awarded to Union Paving Co., San Francisco, $324,547.

SHASTA COUNTY — Between Sulphur Creek and Boulder Creek, about one mile to be graded. District II, Route 3, Section B. Harms Bros., Sacramento, $30,400; A. Teichert & Son, Inc., Sacramento, $33,760. Contract awarded to Poulos & McEwen, Sacramento, $25,458.

Traffic Continues to Show Increases on Three State-owned Toll Bridges

NOVEMBER traffic on the three State-owned bridges maintained the high level recorded in recent months. The average daily traffic on all three bridges increased slightly over October traffic and substantially over November, 1940.

The San Francisco-Oakland Bay Bridge passed its fifth anniversary date on November 12th. In the five years since the opening of the structure 61,690,000 vehicles passed through the toll gates.

The daily average on the San Francisco-Oakland Bay Bridge during November was 56,615 vehicles—151 vehicles over the October average and a gain of 26 per cent over the November, 1940 traffic.

Carquinez Bridge, with a daily average of 14,265 vehicles, showed a gain of 482 vehicles daily over October, and a 50 per cent increase over the November, 1940 figures.

Antioch Bridge, with a 920 daily average compared with 888 in October, gained 48 per cent over November, 1940 traffic.

Total vehicular travel on the three bridges is shown in the following tabulation:

	San Francisco-Oakland Bay Bridge	Carquinez Bridge	Antioch Bridge
Passenger autos and auto trailers	1,529,600	392,405	22,853
Motorcycles and tricars	3,421	841	25
Buses	44,301	5,993	204
Trucks and truck trailers	77,566	28,468	4,476
Others	43,555	245	29
Total vehicles	1,698,443	427,952	27,587

Last Span of Pit River Bridge Erected

(Continued from page 12)

99 on the upper deck across the deep Pit River Canyon, 11 miles north of Redding. The canyon will become an arm of Shasta Reservoir after the Shasta Dam across the Sacramento River about eight miles down stream from the bridge is completed.

Construction of the bridge piers was started in November, 1939, and the first steel was placed for the superstructure in December, 1940. Supported by towering concrete piers of record height, the heavy steel spans were erected from both sides of the canyon. The span will have an overall length of 3,588 feet, including short highway approach viaducts on either side. The highway girder spans on the north side connecting with a highway approach road are yet to be erected. Southern Pacific railway tracks are being laid on the lower deck of the bridge.

In addition to riveting, the work of installing handrails, ladders, locomotive blast plates, and utility lines still is under way on the main spans. The concrete floor of the highway deck has been poured on four spans at the south side. Painting of the bridge is under way but probably won't be completed until some time after it is in use.

AUXILIARY WORK RUSHED

Meantime, work is being rushed on auxiliary features of the 30-mile railroad relocation which is to replace the existing 37-mile canyon line, part of which will be flooded out by Shasta Dam. All the roadbed grading, all 12 tunnels, and seven other bridges are completed, with track laid on the entire line except the Pit Bridge and a few sidings.

Under six separate contracts, various buildings and facilities are being constructed to prepare the new line for railroad operation. These include stations, section houses, water tanks, electric systems, water-supply and sewerage systems at sidings located at Buckeye, Boomtown, O'Brien Creek and Lakehead. An oil storage tank and fuel-supply station are being built at Buckeye.

State of California

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Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

FRANK W. CLARK, Director of Public Works

FRANZ R. SACHSE, Assistant Director

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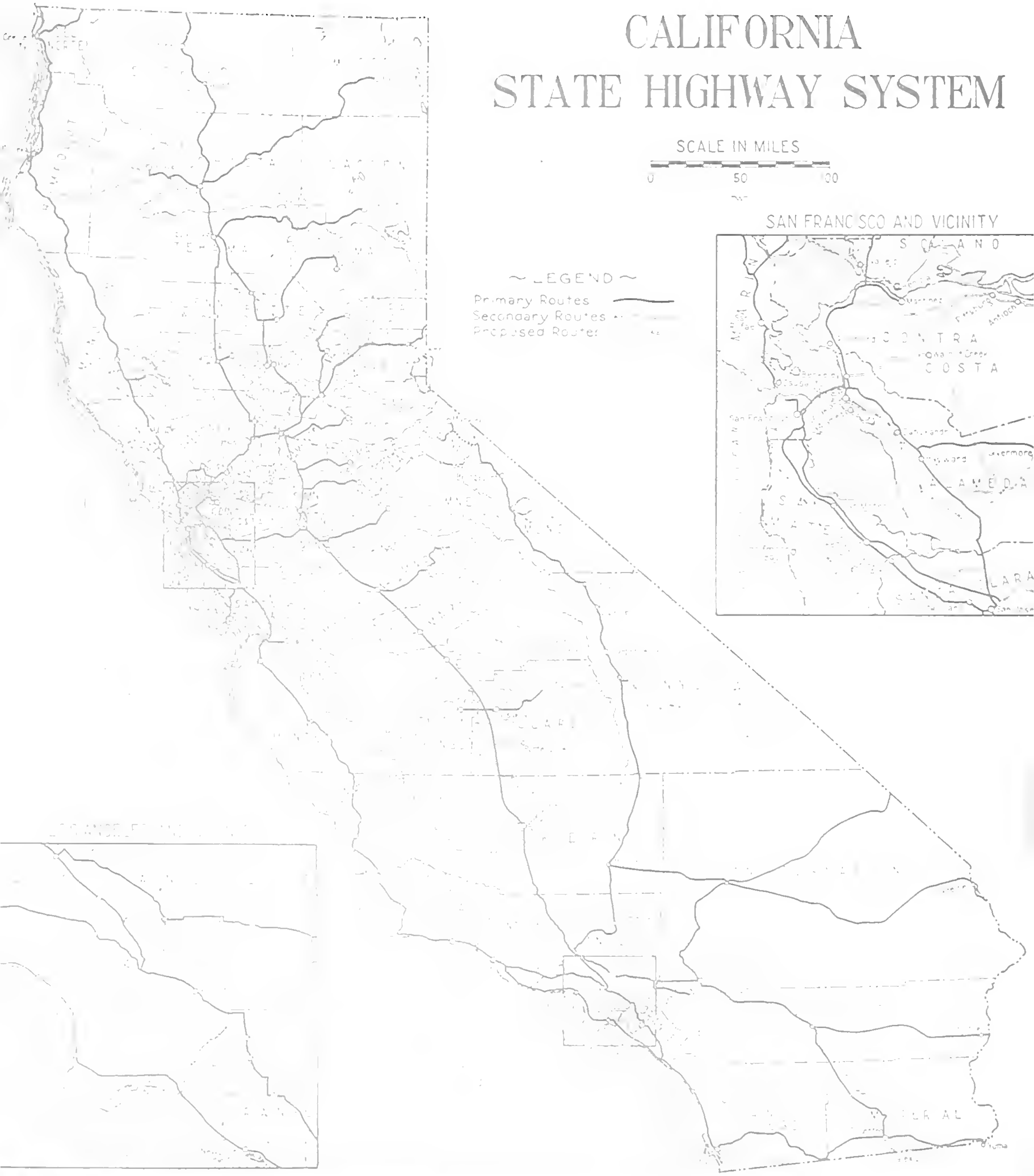
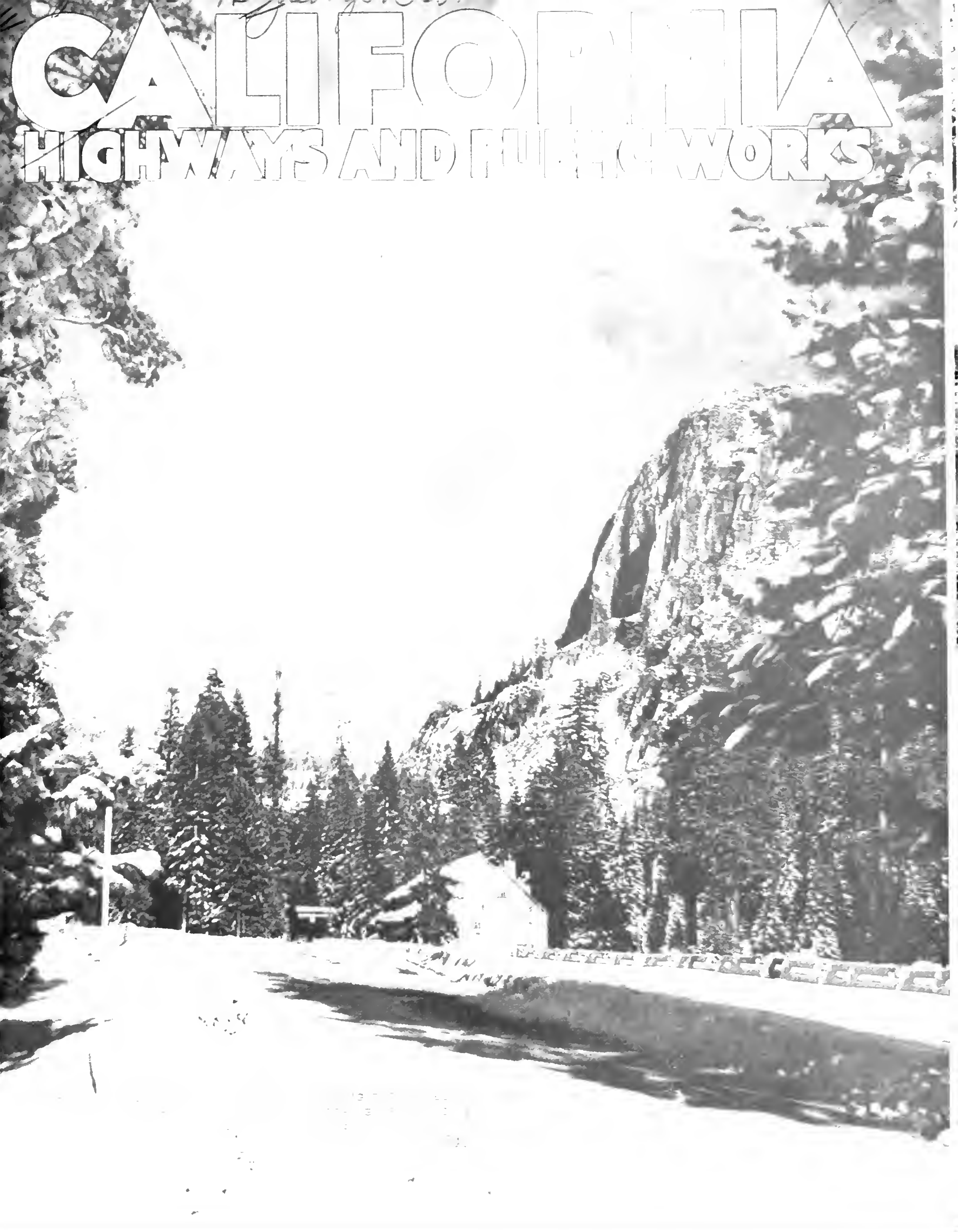


CALIFORNIA HIGHWAYS AND PUBLIC WORKS



Normal Activities of Department of Public Works Subordinated by Defense Highway Construction

By FRANK W. CLARK, Director of Public Works
Vice Chairman State Council of Defense

WAR defense work will subordinate normal activities of all divisions of the State Department of Public Works during 1942.

While the heaviest burden of defense efforts which will be undertaken by the department will be borne by the Division of Highways, the Division of Architecture and Division of Water Resources will assume increasing responsibilities made necessary by the war.

California, with nearly 1,000 miles of coast line, three of the largest ports of supply for the Pacific, some of the greatest ship building and repair facilities, enormous air craft manufacturing centers, and numerous Army, Navy, and Marine establishments, is confronted with a defense problem of magnitudinous proportions.

The California Division of Highways in cooperation with the United States Public Roads Administration, has been engaged since October, 1940, in the study and development of detailed plans for access roads and structures required by military and naval establishments and defense industry. The extent of this undertaking was evident from a study of the appended tabulation which sets forth access road projects, the estimated construction cost of which, including rights of way, is in excess of $45,000,000.

The war begun by Japan against the United States has changed the entire aspect of the strategic and access road plans as tentatively prepared for this State and will necessitate a greatly enlarged program of defense highway construction.

At a recent meeting in my office attended by Colonel Arthur Wilson of the General Staff of the United States Army and officials of the Public Roads Administration, the importance of speed in the highway program mapped out for us by the Federal Government was emphasized. A list of the proposed strategic and access roads in California was checked over by Colonel Wilson. He suggested that certain additional roads that had not been contemplated would be necessary.

The California Highway Commission, of which Larry Barrett of San Francisco is chairman, is giving complete cooperation to this department and to State Highway Engineer C. H. Purcell in carrying out the plans of the Army and the Navy.

The highway projects now under consideration were initiated as the result of conferences held in accordance with instructions issued by the Army and the Navy authorities.

Both instructions provided that all conferences be called by the commanding officers of the posts, the conferences to be attended by representatives of the Corps Area Commander for Army projects or the Commandant of the Naval District for Navy projects, by representatives of the Public Roads Administration, the Division of Highways, Work Projects Administration, county or city officials as the case might be. Subsequently, the responsibility of constructing access roads to exempted stations, consisting in the main of air fields, was transferred from the Corps Area Commander's office to the United States Corps of Engineers. Consequently, representatives of this latter Federal agency were in attendance at recent conferences on exempted stations.

The purpose of these conferences was to determine the access road needs of each particular post, to determine the kind and amount of assistance which the Public Roads Administration, the State Highway Department, Work Projects Administration and the city or county were prepared to give.

Generally, the State and local agencies were able to provide little financial assistance as most of the designated access roads are not on the State Highway System and gas tax funds could not be used on them.

Early construction of these projects was limited to those undertaken by the Work Projects Administration. At one time it was thought that many of the access roads would be constructed by the Work Projects Administration but the quick upswing of defense activities so depleted the available WPA labor that many projects had to be dropped from their program.

The great bulk of the projects remained therefore to be built by other agencies. The only means of financing such an enormous program of access roads is by Congressional appropriation. The first bill embodying appropriations for this character of work was passed by Congress on July 24, 1941, and later vetoed by the President.

Subsequent legislation was introduced and finally passed by Congress and signed by the President on November 19, 1941. The final terms of the bill as passed and as approved by the President provides $150,000,000 for access roads for the entire United States, $25,000,000 to be apportioned to the States for the improvement of the strategic network to be allocated under the regular Federal Aid formula, $25,000,000 to be allocated directly by the President and $10,000,000 for flight strips. The allocation of these flight strips is to be determined by the Army air authorities and their purpose is to provide supplemental landing fields parallel to strips of highway at various locations in the United States. Ten million dollars was appropriated for surveys and plans making a total of $220,000,000.

The total of the projects as listed approximates $15,000,000. Several of these projects are under way at the present time under Work Projects Administration allocations but some of the projects listed probably will not be included in the list of priorities of projects as prepared by the War authorities.

The Army and Navy authorities have been working diligently in preparing a list of projects in order of priority so that funds as they become available will be applied to those projects considered by the Military authorities of highest importance.

The tabulation of projects attached does not include cost of certain designated access roads for which preliminary engineering is being performed by the Public Roads Administration nor the cost of designated access roads to certain defense industries.

As a result of the various post conferences held since October, 1940, and at intervals throughout the entire year of 1941, the State has been authorized by the Public Roads Administration to prepare access road plans. The cost of this preliminary engineering has been financed entirely with Federal funds which had previously been apportioned to California as Federal aid on normal construction programs.

Plans and specifications have been completed on many of these projects and the State is prepared to advertise more than $18,000,000 worth of projects, pending of course, the securance of rights of way. The cost of rights of way may or may not be included in the allocation of funds for a particular project.

One of the important duties of the Division of Highways in the present war emergency is the guarding of approximately 150 highway bridges of military value. This function is performed by the Maintenance Department of the Division. These structures, including the San Francisco-Oakland Bay Bridge which is being patrolled by the State Guard, are under 24-hour protection. In addition, the Maintenance Department through arrangements with Pacific Telephone Company, maintains a direct connection with 21 swing drawbridges operating on 21 navigable streams in Sacramento, San Joaquin, Napa and Sonoma counties.

Immediately following an alert warning or orders for a blackout, the bridge tenders on these spans are notified by telephone to douse all lights. A special crew stationed in an office of the Maintenance Department in the Plaza Building in Sacramento performs this work. The Maintenance Department also is guarding numerous powder houses on various highways throughout the State and has made available to the Army its maintenance shops for use in connection with the repair of Army transport vehicles. Certain highway construction equipment required by the Army has been provided by the Division of Highways.

In connection with the guarding of the San Francisco-Oakland Bay Bridge and the State-owned Carquinez and Antioch bridges, I wish to compliment very highly The Adjutant General's department for the rapidity with which armed guards were made available. In the case of the San Francisco-Oakland Bay Bridge, armed guards took over from the maintenance men by 2 o'clock on the morning of December 8th, or within 14 or 15 hours after the actual outbreak of hostilities. In the case of the Carquinez and Antioch bridges, State guardsmen took over at about 2 o'clock on the morning of December 9th.

The Division of Water Resources in cooperating with the Reclamation Board and the United States Army engineers has completed a comprehensive survey of the entire levee system in the Sacramento-San Joaquin Valley and delta with the view to providing adequate patrols against sabotage in high water areas at points of particular importance from a military standpoint.

The Division of Architecture is engaged in preparation of uniform plans for sirens, safety features for public buildings, particularly schools, and provision of standby or emergency utility services to State institutions.

At the present time, more than 155 employees of the Department of Public Works are on military leave. The Division of Highways alone has given 136 employees to the armed forces of the United States and already 16 employees of the Division of Architecture are in service.

I want every citizen of California to know that the entire staff of this department has placed itself in the service of the military authorities and the authorities charged with the civil defense of California. As a result certain delays in completion of plans and specifications on budgeted highway projects may well occur as there can be no question but our engineering services must be first made available to those essential strategic or access road projects that are requested by the military and naval authorities.

(Table of Designated Military and Access Highways on pages 18-20.)

Victory Book Campaign

Sponsored by the USO, Red Cross and American Library Association, the Victory Book Campaign opened Nation-wide January 12th to continue for one month. The goal is 10,000,000 books for our armed forces. Take your gift books to your nearest public library. Magazines are not desired at this time. The need is very urgent. Mabel R. Gillis, California State Librarian, is State Director. There is a local director in each locality where there is a public library. Books needing repairs will be repaired. Our American defenders are particularly eager for up to date technical material to help with their problems, as well as books on current affairs and plenty of good fiction. Give a man a book he can read.

Daughter of Engineer Tilton Assistant to Winant in London

To fly to Europe is an exceptional experience, especially when the destination is at the hub of World War activities. Such has been the role of Edith Tilton Denhardt, daughter of Assistant Construction Engineer G. A. Tilton, Jr., of the State Division of Highways.

Mrs. Denhardt was appointed special economic assistant to United States Ambassador Winant at London, England, and recently flew there on the Atlantic Clipper to take up duties in the United States diplomatic service.

Mrs. Denhardt is a graduate of the University of California in Economics and was prominent as a member of the debating team for four years, becoming forensic commissioner in her last year.

Highway Tree Maintenance Improved by Trained Crews

By E. S. WHITAKER, Assistant Landscape Engineer

IN THE 10 years from 1929-30 to 1939-40 there has been a marked change in highway tree maintenance work as performed by crews of the Maintenance Department of the Division of Highways on State right of way. The change in this relatively short period has been the direct result of a betterment in the methods of operation due to the work having been consigned to crews composed of men selected for their ability to properly care for trees and landscaping.

Expenditures for tree maintenance during the year 1929-30 amounted to $84,320.05. Work consisted mainly in the care of planted trees, as there were few intensively developed landscaped portions of roadsides, and little corrective attention was given native growth on the right of way. In that year the State highway personnel included two highway tree trimmers and one tree foreman, operating in three of the then 10 highway districts.

During 1939-40, expenditures for this same kind of work amounted to $203,690.49. In this year there were 24 tree crews composed of 17 tree foremen, 33 tree trimmers, and 62 groundsmen, equipment operators, and laborers, operating full time on tree maintenance in 10 of the 11 highway districts. Their work consisted of the care of all planted and native growth on the right of way with a considerable amount of this being composed of highly developed landscaped areas.

While the increase in expenditures during this 10 years has been the natural result of a steady development of our roadside landscaping program, this increase would have resulted regardless of the manner in which the necessary maintenance work was done. The increase in personnel, however, has been the result of the following conditions:

MEN TRAINED FOR JOBS

1. Even before the exceptional increase in landscaping, it was realized that tree planting and maintenance could not be done practically by regular maintenance crews. Not only were these crews unable to properly handle the work, but there was a decided conflict in desirable times for accomplishment of roadway maintenance and tree maintenance. By establishing tree crews of men trained in tree maintenance work, and in recognizing that timely tree maintenance is necessary to prevent a partial or even a total loss of the original planting investment, the greatest possible advancement toward economic tree maintenance resulted. Costs of the work would be far in excess of the present figures, were this work done by crews not trained in tree and landscaping maintenance.

2. In 1933 the State Highway System was practically doubled by the inclusion of 6045.18 miles of county roads. In general a large amount of work was immediately necessary to bring conditions affecting roadside growth on these roads up to the standard set by the division for sight and restriction clearance, and for other tree reconditioning work. Tree crews were increased in personnel to

Clearance restricted roadside and private property trees and view from same point after tree trimming

Showing palm trees lining highway before and after trimming

care for this semiemergency and, due to events that followed, were not subsequently reduced.

FEDERAL AID GIVEN

3. The year 1934 saw the first allocations of Federal Aid funds for roadside landscaping, that resulted in the establishment of extensive and highly developed roadside landscaped areas and caused an immediate increase in the amount of necessary tree and landscaping maintenance. A further yearly increase in the total area of landscaped roadsides has necessitated additions in personnel to the tree crews.

The growing conditions affecting plant life in practically all portions of the State served by the highway system are of such extremes considering climate and soil, that the maintenance of large plantings of trees and shrubbery, even under what might be considered as normal conditions, continues to be necessary even when plant maturity is reached.

Best example of this type of work is the summer watering program in which 21 tank trucks of from 1,000 to 2,000 gallon capacity, work from May to October to water trees and shrubs. While the greater proportion of this work is done in the central valleys and elsewhere away from the coastal fog belt, it is generally necessary to water all new tree plantings through at least their first two summers to obtain good growth.

PEST CONTROL WORK

In the lower San Joaquin Valley in a semidesert area trees are still being watered throughout the entire summer that were planted in 1925. There is no reason to believe that this work can be discontinued so long as it is desired to keep these trees alive.

Insect, pest, and rodent control is another portion of each year's tree maintenance program regardless of the age of the plants. In bad years costs have aggregated $6,000 for this work alone. In districts where a yearly recurrence of infestations is certain, tree crews operate State-owned tree spraying equipment and there are now available, when needed, five high pressure spray rigs in as many districts. Elsewhere, when infestations are sporadic or small, the work is done under service agreement by local commercial operators.

There is also the problem of securing the public's appreciation and proper treatment of roadside developments. Trees damaged or destroyed by traffic are a common occurrence as is also the loss of young planted stock

(Continued on page 28)

Eucalyptus trees on highway before and after top work

THE new $675,000 San Rafael Viaduct, which breaks a serious traffic bottleneck in the heart of the City of San Rafael, is now entirely completed. The viaduct provides a four-lane divided highway over approximately five city blocks of residential and industrial property in San Rafael, providing five grade separations which will speed up traffic through the city and eliminate dangerous congestion.

The structure occupies the channel of Irwin Creek, a stream which carries the run-off from practically all the streets in the eastern portion of San Rafael. It has a total of 67 spans, varying in length from 17 feet to 57 feet 6 inches. It is 2,207 feet 6 inches in length.

The viaduct structure itself cost $402,000; the roadway work $153,000, and the Linden Lane Underpass, which carries traffic beneath the viaduct, $120,000.

The upper picture shows the northern approach to the viaduct and the lower is of the deck of the structure.

Motor Transport of Tomorrow Will Be Big Post-war Problem

At the meeting of the American Association of State Highway officials in Detroit, Mr. Paul G. Hoffman, president of the Studebaker Corporation and vice president of the Automobile Manufacturers Association, delivered an instructive address on the problems of highway motor transport which will have to be met after the war. His remarks follow:

THERE'S an old saying that history repeats itself. I have proof of that in a bulletin issued by the National Automobile Chamber of Commerce to its members under date of August 1, 1917.

The bulletin contained a list of "Don'ts."

The first one said: "Don't call it a pleasure car. Call it a passenger car or automobile."

Down at the bottom of the page, the last one said: "Don't take too seriously the talk about failure of the supply of gasoline."

Despite that solemn resolution of 1917 against the expression "pleasure" car, I saw it recently in two New York newspapers. I have heard it used repeatedly during the last few months by Government officials in Washington.

And as for the gasoline shortage, well, perhaps you have read something lately about that yourselves. I don't know who is right, but I do say that it is a matter of "horse sense" that we all ought to do all we can to conserve fuel.

ABRUPT ABOUT-FACE

It wasn't altogether strange that the automobile manufacturers found it necessary in 1917 to suggest a shift of phrasing from "pleasure" to "passenger" car. It was an abrupt about-face. They had spent the previous twenty years trying to convince a doubting public that there was any pleasure in driving the contraptions they were building during that period. Furthermore, the idea that the 5,000,000 motor vehicles in operation in 1917 might play an important part in the transportation picture was just beginning to take hold not only with the public but with the manufacturers themselves.

It is startingly strange today, however, that a single person out of our

PAUL G. HOFFMAN

130 million Americans would fail to recognize the position which motor vehicles now occupy in the transportation field.

The 5,000,000 motor vehicles of 1917—and there were less than 2,000,000 when the World War started—have been multiplied into 32,000,000 today. These cars and trucks pile up in a year nearly 500 billion passenger miles of travel, more than six times as much as the total travel of all other forms of transportation in the country combined. Four-fifths of this mileage is by automobile.

Moreover, the road use surveys which were made by your organization, in cooperation with the Public Roads Administration, show that well over half of the passenger car travel, on a mileage basis, and three-fourths of it, measured by the number of trips, are for driving to work, to market, and in the other necessary transportation jobs which are linked with day-to-day economies of American life.

GAS SHORTAGE PROBLEM

As for talk in 1941 of gasoline shortages, we already have seen fuel rationing, of sorts. There has been mention of "gasless Sundays." But no one in the United States has yet proposed a "gasless Monday." That would be something for Mr. Hitler's gestapo agents to promote. "Gasless Mondays" would close our schools, curtail our food supply, cripple industry and business, and plunge our economic and social activities into chaos and inefficiency.

If we face a shortage of gasoline, then we should meet it by a sensible rationing plan which will permit uninterrupted essential uses of any or all motor vehicles. After all, millions of defense workers depend every day on their private cars to get them back and forth from home to office or factory.

Recent surveys show that 82 per cent of all workers in a Youngstown, Ohio, steel center use their own automobiles or ride with fellow workers to and from their jobs. At an aircraft center in Glendale, California, the percentage was 87. In Midland, Michigan, the figure is 92 per cent. Nine thousand employees at an airplane plant near Seattle arrive daily in 3,000 passenger cars from distances as great as 40 miles away. The same picture prevails in defense centers everywhere, from coast to coast.

Whether we measure its use statistically, or whether we examine its effect upon the life and habits of the individual, the motor vehicle emerges clearly today as an essential factor of major importance to both our civilian and defense economy.

HIGHWAY BUILDING PROGRAM

All this has happened since the turn of the century. A revolution has occurred in the American way of life;

a transition in which the manufacturers of motor vehicles have taken a part. Yet all we do is supply the rolling stock. We have built and sold in 41 years approximately 81,000,000 cars and trucks. These vehicles would have no place to go—in fact, most of them would not have been manufactured at all—if you gentlemen and your profession had not accomplished during this same period the most gigantic road building program in the history of the world.

The enormous usefulness of motor transport to America's civilian economy, and the vital contribution which it is making to the defense program, are, therefore, tributes to the administrative leadership and the technical skills which your profession has given to the country during this period.

The year 1941 marks two important anniversaries in the history of motor transportation in the United States. It was in 1901, 40 years ago, that the good roads movement was put under way by groups of citizens interested in coordinating what formerly had been haphazard and piece-meal road planning and building.

ROUTES FOR DEFENSE

In 1921, just 20 years ago, the existing Federal Aid Highway Act was passed by Congress and approved by the President, largely as a result of the continuing good roads movement. Many of you present this evening were active in that movement.

In many ways, the 1921 law marked the beginning of the development of National highway transportation in this country within the framework of the American political system, for it established the broad principle of Federal aid, under which the Federal Government, in granting funds for road work, gives necessary direction to highway activities but permits direct responsibility for highway projects to be retained by the States.

Under this policy, we have succeeded in building a great public road system which surpasses anything the world has ever seen. More than 3,000,000 miles of streets and roads, including approximately 80,000 miles of highways selected in cooperation with the War Department and approved by the Secretary of War as a strategic network of routes for the National defense, bind the Nation together in a vast transportation network.

Since the Federal Aid Act was passed, we have made an investment in public roads estimated at 21½ billions of dollars. We have created as a result of this policy great new industries. More than 200,000 persons were employed last year on State and Federal roads alone. Motor transport as a whole provided the pay checks for one-seventh of all the gainfully employed in the Nation.

UP TO AMERICAN PEOPLE

If you stopped a thousand people at random on the street, I doubt whether half a dozen of them could tell you anything at all about the history of our road movement, about the meaning of Federal Aid to the States, or about the master plan as a peacetime charter for future highway development. The public simply doesn't know. Clearly we must focus attention now on this big problem. We must promote a wider and clearer public understanding of the important issues involved.

I have abiding faith in the judgment and sanity of the American people. Once they have the facts, they will act on them intelligently. Once they learn the glorious record of highway development in this country; once they are acquainted with your great plans for the reshaping of highway transportation, you will have their full support. With that support, I can visualize a development within the next 20 years that will not only make America a better country in which to travel but also a better place in which to live.

(Excerpt from address of Paul G. Hoffman to State Highway officials in Detroit.)

ADDITIONAL TRAFFIC BURDEN

As we face the National emergency which has come in 1941, we can well be thankful for the development of this great enterprise. Perhaps we should also be regretful that so much of our highway tax revenue has been diverted to other purposes. During the six years 1935-1940, nearly one billion dollars of highway tax revenues, or one-eighth of the total collected, were diverted.

You gentlemen know too well that you could have used that billion and perhaps 10 more, because the demands on our highway system even in normal times far outstripped our building and modernization program.

Today highway transportation faces not only a normal burden but billions of miles of additional travel superimposed by the defense program. I wish I could say that highway transportation is prepared fully to take on this additional burden and to handle the assignment safely and efficiently.

But I do not believe this to be true. Through no fault of yours, our highway system is inadequate. Through no fault of ours, a substantial percentage of the rolling stock is obsolete. During the depression years, from 1931 through 1934, not enough new cars were built to take care of the ordinary replacement demands.

Let us first take a square look at our transportation pool of approximately 27,500,000 passenger cars. That is an impressive total, but today one car out of every five you see in service is over 10 years old. That percentage is abnormally high. In 1935, for example, only one car out of 15 cars registered was that old. It is a great tribute to the motor car that millions of Americans depend every day upon these venerable jallopies to provide them with indispensable transportation.

Whether highways and rolling stock are as efficient as we would like them to be, they are faced with a tremendous transportation job, in which all of us are directly interested.

TWO PHASES OF QUESTION

In so far as highway facilities are concerned, the easy way would be to undertake at once large-scale building and modernization programs. But that method also is out due to the priorities which have been created by the stresses of the emergency.

From the standpoint of highway facilities, therefore, the immediate problem appears to have two phases:

1. To increase sharply the safety and efficiency of the existing system of roads and city streets.

2. To alleviate by modernization and a minimum amount of new construction the acute problems in critical defense areas.

Both angles of the problem present difficulties.

In the field of safety, there is little or no public recognition of the extent to which accelerating defense activities have increased traffic accidents.

(Continued on page 26)

Joint Legislative Committee Tours State Holding Hearings on Water Problems

Starting at Redding, December 1st, the Joint Legislative Interim Committee on Water Problems, inspected Sacramento Valley units of the Central Valley Project, the State Water Plan and the Sacramento River Flood Control District. Members on the committee on the tour shown above are, right to left, first row, Frank Reed, executive secretary of the committee, Senator Charles H. Deuel, Chico; Senator Bradford S. Crittenden, Stockton, committee chairman; Senator Robert W. Kenny, Los Angeles; Assemblyman Clyde Watson, Orange; Assemblyman Rodney L. Turner, Delano, vice chairman. Back row, left to right, Senator R. R. Cunningham, Hanford; Assemblyman Seth Millington, Gridley; and Assemblyman Gordon Garland, Woodlake.

DURING the first week in December the members of the Joint Legislative Interim Committee on Water Problems toured the Sacramento Valley on the first of a series of inspection trips which will take them to all parts of the State on a study of water problems.

The committee was authorized and its work outlined in Senate Concurrent Resolution No. 11, Chapter 130, Statutes of 1941. Committee members are: Senator Bradford S. Crittenden, Stockton, chairman; Senator R. R. Cunningham, Hanford; Senator Charles H. Deuel, Chico; Senator Robert W. Kenny, Los Angeles; Senator Ed Fletcher, San Diego; Assemblyman Rodney L. Turner, Delano, vice chairman; Assemblyman Gordon Garland, Woodlake; Assemblyman Gardiner Johnson, Berkeley; Assemblyman Seth Millington, Gridley; Assemblyman Harold F. Sawallisch, Richmond; and Assemblyman Clyde Watson, Orange.

The committee spent a day inspecting Shasta Dam and power plant, highway and railroad relocation works, and the afterbay dam and power plant at Keswick. On succeeding days they viewed areas damaged by Sacramento River floods; the levee and by-pass system of the Sacramento River Flood Control Project; sites of proposed units of the State Water Plan on the Sacramento, Feather, American and Cosumnes River; the Delta Cross Channel and the Contra Costa Canal units of the Central Valley Project and the Stockton Deep Water Channel.

Public meetings were held in Redding, Red Bluff, Chico, Willows, Colusa, Marysville, Sacramento, Auburn, Pittsburg and Stockton. At these meetings local representatives laid before the committee their problems, ranging from requests for reservation of storage space in Shasta reservoir for the future development of lands in the Sacramento Valley, through pleas for additional river control, drainage and seepage relief, the development of additional units of the State Water Plan and that power developed by the Central Valley Project be made available for various public agencies.

"I'd like to get married and settle down," said the young chap, "but I guess I have to stay single and settle up."

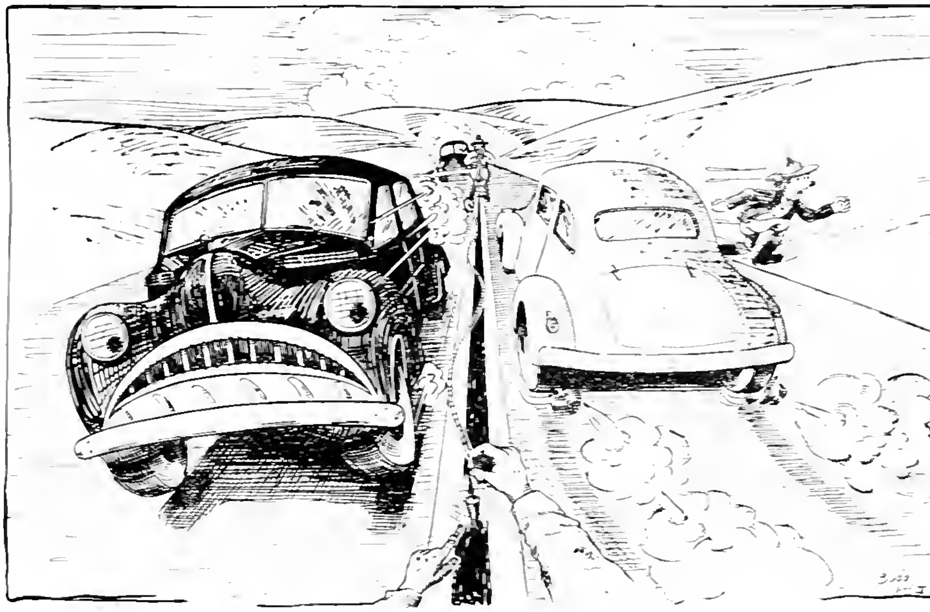
Reckless Drivers Make Life of Highway Surveyor Dangerous

By B. VAN DALSEM, Senior Engineer

A SURVEY party is working along the center line of one of our busy highways. Warning signs have been placed several hundred feet each side of these men. Flagmen have been stationed between these signs and the surveyors. Here we have the setting of a drama which occurs almost daily somewhere along our highway system.

This survey party has avoided working on the pavement as much as possible, but this is one of those occasions when it is impossible to do otherwise. The men are nervous and there is no reason why they shouldn't be, for they have had to perform this type of work many times before. They are fully aware of some of the events which are to follow.

The transitman now has his instrument in adjustment and the two chainmen have stretched their tape down the center stripe. Cars are streaming past this group continuously.



Cartoonist's conception of hazards encountered by highway surveyors

RECKLESS DRIVERS

The transitman glances quickly into his note book for information. His eyes fly from the book to an approaching motor car and back to the book again. The two chainmen are astride the traffic stripe, facing each other. Each is watching the traffic approaching him to his left. Now the transitman is ready. The chainmen crouch down. The head chainman straddles the stripe, but the rear chainman must move to the left of the division strip, that the instrument man may see past him. They are now busily engaged in setting a point.

The transitman shouts his instructions to the men, for he knows from experience that it is best to make as few motions as possible, lest he confuse a passing motorist. The point is set and the men move ahead to another. Once more they squat. Suddenly the rear chainman rises to his feet. This is a signal to the other man that all is not well behind him. He, too, is on his feet.

An automobile is hugging the stripe. The head chainman motions him over, glancing over his shoulder, making certain there is room for him to step back if he is forced to do so. The car swerves back into the center of its lane, and as he reaches the rear chainman, the driver shouts something which is unintelligible to the worker, but which, he is certain, is not taught in Sunday School.

DANGEROUS WORK

Most of the motorists give the workmen a wide berth, as they continue to set their survey points, but the majority of them do not slacken their speed. Oh! Oh!—here comes a car at a terrific rate of speed. The flagman motions the driver to slow down, but he still comes at the same speed. He misses the leg of the transit tripod by a matter of inches! He's too close to the center line! Both chainmen are on their feet. Now what will he do? Why, he blows his horn of course, and misses them by inches also.

By now the chainmen are too far away from the transitman to hear his instructions. The only course left to make his men know where their point should be set is to signal with his arms. He tries to wave his arms as little as possible, but at that, a motorist has mistaken these motions as a signal for him to pass on the left. The instrumentman must now do his best to get the car back in its proper lane. He succeeds in doing so, but receives a "dog eye" from the driver as he passes by.

What is that noise behind him? It is the screeching of brakes. A courteous motorist has slowed down for the flagman. But why all the noise? That car behind him was traveling too fast and had to cut out in order to avoid a crash. All is well!

The chainmen are nearing the flagman farthest away from the transitman, and as he glances through his

(Continued on page 21)

Third Niles Canyon Improvement Is Rapidly Nearing Completion

By J. E. BURKE, Resident Engineer

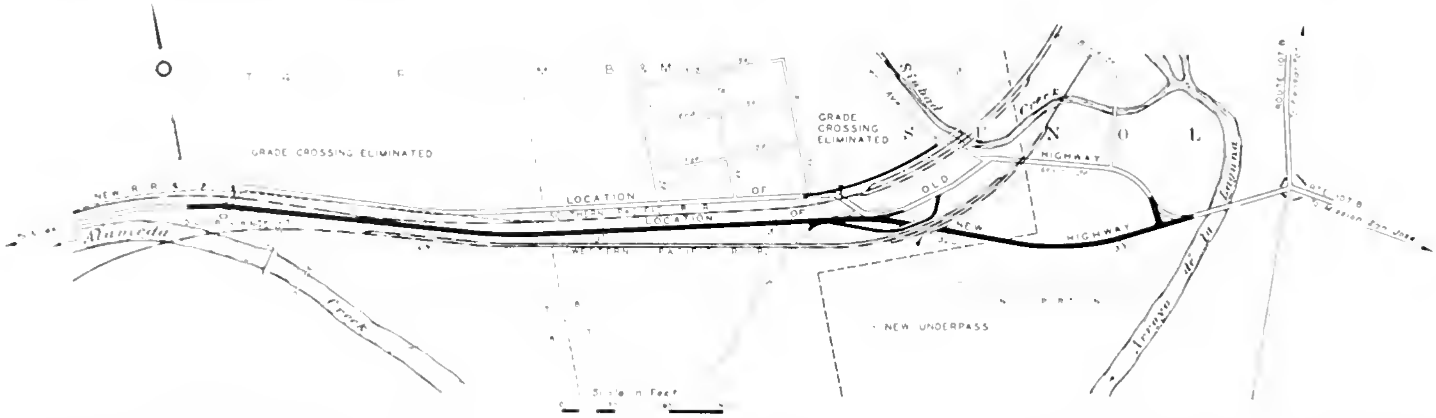
NESTLED among the hills of southern Alameda County, is the little town of Sunol which now has a subway and traffic separating layout nearing completion that will adequately serve her needs.

The Sunol separation is the third major improvement to that portion of Route 107, Section A, known as the Niles Canyon Road. At the time this route was accepted into the State's Secondary Highway System, the six miles between Niles and Sunol crossed Alameda Creek three times and Arroyo de la Laguna Creek once on narrow through truss steel or light timber bridges and crossed the Southern Pacific tracks twice and the Western Pacific once at grade. These three grade crossings were extremely dangerous to highway traffic due to short approach curves and limited sight distances.

NEW MODERN BRIDGE

The first improvement on this route was replacing of the old and narrow steel through truss bridge over Arroyo de la Laguna Creek with a modern reinforced concrete structure of the continuous girder type. The old bridge consisted of two 120-foot spans; the easterly half being erected in the 1880's and the westerly half in the spring of 1904 after extremely high water had washed out the timber bents originally constructed there. The new structure with 26-foot clear roadway width and two 4-foot sidewalks is constructed over five reinforced concrete piers on spread footings. It was completed in the fall of 1939.

The second improvement consisted of a major change in alignment of the first mile of Route 107 from its junction with Route 5 (Sign Route 17). In order to realign this portion and thereby eliminate two more old steel through truss bridges, it was necessary to construct a new channel for Alameda Creek for almost the entire distance of the contract. This provided room for the new highway between the creek and the Southern Pacific tracks on the north wall of the canyon. This highway construction was completed in the late summer of 1940.



SUNOL SEPARATION

The Sunol separation, which includes a mile and a tenth of relocated highway with the separation structure, eliminates the three grade crossings and bypasses through traffic from the town of Sunol, leaving only one antiquated bridge yet to be modernized.

Beginning approximately a mile west of Sunol and opposite the Silver Springs Dam, the new highway runs eastward between the Southern Pacific and Western Pacific tracks to the west edge of Sunol where it crosses under the Western Pacific, skirts the south side of Sunol and ties in with the west end of the new Arroyo de la Laguna Creek bridge. In order to eliminate the two Southern Pacific grade crossings it was necessary for the new highway to be constructed between the two railroads. Before that could be done, one of the railroad tracks had to be moved to provide the required room for the highway. It was finally decided because Southern Pacific was almost entirely in cut section and Western Pacific entirely on fill section, the Southern Pacific could be more easily shifted.

Approximately 24,500 cubic yards of earth had to be moved to allow shifting of 3,300 lineal feet of track a maximum of 65 feet. Another 2,500 yards were moved to provide a detour for the existing Route 107 as the new location of the railroad coincided with the existing highway location.

After the grade had been prepared for the railroad by the State's contractor, the tracks were shifted by means of a tractor which dragged the rails and ties by a cable sling as far as the slack in the rails would allow.

A new connection between track and tractor was then made and another pull taken. After about 1,000 feet had been moved, sharp kinks in the rail were bulldozed out by the tractor and the track then lined up for grade and alignment by the railroad's extra and section gangs. Three days were required to roughly relocate the 3,300 feet of track and it could have been done in less time than that had it not been necessary to keep the track open to allow the passage of regularly scheduled trains. Trains traveled

Upper—View of newly completed highway directly west of Sunol, looking toward Niles Canyon. Center—New Sunol underpass. Lower—Underpass at Sunol under construction

Old grade crossing west of Sunol, showing new highway on left beyond railroad crossing. Project eliminates three grade crossings

the track during relocation over double "S" reverse curves at six miles an hour without mishap. The objectionable feature to this method of relocating track was the large number of ties which were either broken in two by becoming skewed or which were split at the spikes from the same cause.

After all relocation work was completed, ballast was hauled in and dumped and the track raised to its ultimate grade. The relocation work, including contract work of excavation for both detour and railroad, surfacing detour and extending culverts and constructing new headwalls for the railroad, cost approximately $15,500.

The Western Pacific Railroad operated on shoofly track along the east side of the structure during the construction of the separation. The structure is of reinforced concrete abutments and wing walls on spread footings without foundation piling. The abutments are constructed sufficiently far apart on the skew to the railroad to provide a 26-foot clear roadway and two sidewalks each four feet wide. The front faces of the abutments and wings are battered and fluted to provide a very pleasing modern design.

The structure carries the Western Pacific's main line and Sunol passing track and a 24-foot highway on a system of two 6-foot girders connected by 24, 27 and 30-inch wide flange steel beams. The beams are stiffened by 18-inch channel diaphragms and covered by wrought iron plates under the railroad portion and by a concrete deck under the highway portion. The wrought iron ballast plates are welded together at the joints after being riveted to the upper beam flanges.

All other structural steel connections were riveted, and all steel was erected by the contractor's gas shovel with a crane boom. In order to raise the 20-ton girders it was necessary to counterweight the back of the shovel with sand bags. However all raising operations were completed without danger. The wrought iron ballast plates were waterproofed after welding and riveting were completed with a mopping of hot bitumastic enamel and a 1½-inch compacted thickness of plant mixed surfacing.

The railroad and highway sections of the structure are separated by a 12-inch high and 2-foot 6-inch wide concrete curb topped by a laminated timber guard rail with the posts embedded in the curb. An 18-inch walkway is provided along the east side of the structure for the convenience of trainmen and a 36-inch sidewalk along the west side for pedestrians. Both are of checkered plate. The steel girders, along the outside of the walkways, protrude above the walkways about 30 inches and are topped by pipe handrails which extend out along the tops of the wing walls.

Subway drainage is provided by an extensive system of perforated and corrugated metal pipes and by catch basins which transport the storm waters to a sump constructed near the end of the southeast wing. From the sump it is pumped by one of two 10-horsepower motors through a 12-inch welded steel pipe to a paved ditch along the south side of the new highway, ultimately emptying, through a 30-inch pipe, into Alameda Creek at a point about a mile west of the pump house.

The highway section of the structure carries the Sunol approach road. This service road diverges from the main highway about 300 feet west of the west subway approach cut, flanks the subway on the south side to the structure and then crosses over the main highway, providing a method for traffic traveling from Niles to Sunol to drive into town without crossing opposing traffic.

COST TO STATE $152,500

For traffic traveling west from town, another service road has been con-

(Continued on page 21)

Proposed State Water Plan Units Would Develop Two Great Valleys

THE Water Project Authority of California, meeting in Sacramento, on November 25th, directed its Executive Officer, State Engineer Edward Hyatt, to confer with Federal authorities and submit various units of the State Water Plan for an extension of the Central Valley Project.

For several months United States Bureau of Reclamation engineers have been investigating the feasibility of developing American River and other units proposed in State Water Plan.

The plan, originated after 10 years of studies by the State Engineer's office. It contemplates the construction for the Great Central Valley basin of 24 major storage reservoirs with an aggregate capacity of 17,817,000 acre-feet of water and six major conveyance units to distribute surplus water developed. Increased capacities at Shasta and Friant dams have boosted the aggregate storage to 19,497,000 acre-feet.

The State Engineer told the Authority that the ultimate plan is designed to furnish adequate supplemental water supplies to care for all domestic, municipal and industrial uses and for the ultimate irrigation of nearly 10,000,000 acres of irrigable land in the Sacramento and San Joaquin valleys and foothill regions. At present only approximately 3,000,000 acres of valley lands are under irrigation. Other primary objectives of the plan comprise restoration and maintenance of commercial navigation on the Sacramento and San Joaquin rivers, control of floods by storage regulation, and the prevention of salt water invasion from San Francisco Bay into the delta of the Sacramento and San Joaquin rivers.

HYDROELECTRIC POWER

In addition to its other purposes, the State Water Plan provides for the development of hydroelectric power at 10 of the proposed storage dams, at five afterbay dams and in connection with the diversion of Trinity River water into Sacramento River basin. An aggregate installation of 1,640,000 kilovolt amperes in hydroelectric plants is proposed. The estimated average annual output of these plants would be 6,800,000,000 kilowatt hours. The cost, excluding units of the Central Valley Project, based on 1929 estimates, would be $455,400,000.

The units of the plan, in addition to those now under construction in the Central Valley Project, are as follows:

AMERICAN RIVER UNIT

The American River unit comprises three storage reservoirs, designated as Auburn, Coloma and Folsom, and three dams for afterbay regulation, together with six hydroelectric plants. This unit provides for combined gross storage capacity of 1,952,000 acre-feet and power plant installation of 295,000 kilovolt amperes capacity. Operated primarily for irrigation the development would provide a total irrigation yield of 1,790,000 acre-feet, of which 1,656,000 acre-feet would be new water. The average annual electric energy output would be 898,800,000 kilowatt hours.

The Trinity River diversion provides for a storage reservoir at Fairview on the Trinity River with gross capacity of 1,436,000 acre-feet. Four power plants with an installed capacity of 193,000 kilovolt amperes would utilize a drop of 1,800 feet to the Sacramento River watershed. Under the ultimate plan of operation the diversion would provide 440,000 acre-feet of water annually for irrigation of lands on the west side of the Sacramento Valley and develop an average annual energy output of 855,000,000 kilowatt hours.

FEATHER RIVER DAM

The Feather River development provides for a dam and storage reservoir on the Feather River above Oroville with a capacity of 1,705,000 acre-feet and an afterbay dam several miles downstream. Power plants operated in connection with the dams would have an installed capacity of 324,000 kilovolt amperes. Operated primarily for irrigation and flood control the unit would provide a total seasonal irrigation yield of 2,610,000 acre-feet, of which 2,040,000 acre-feet would be new water. With slight modification the irrigation yield would remain practically the same and the average annual electric output would be 1,172,200,000 kilowatt hours.

The Narrows reservoir on the Yuba River would have a gross storage capacity of 853,000 acre-feet. It would be operated for irrigation, flood control and power development. Installed capacity of the power plant would be 160,000 kilovolt amperes. Operated primarily for irrigation with flood control and incidental power development the reservoir would develop a total seasonal irrigation yield of 975,000 acre-feet, of which 869,000 acre-feet would be new water. The electric energy output would be 528,100,000 kilowatt hours annually.

Camp Far West reservoir on Bear River is designed for irrigation and flood control. The reservoir would have a storage capacity of 151,000 acre-feet and develop a total seasonal yield of 192,000 acre-feet of water.

NUMEROUS RESERVOIRS

Millsite reservoir on Stony Creek, 10 miles downstream from Stony Gorge, would have a storage capacity of 115,000 acre-feet and would provide a total seasonal irrigation yield of 92,000 acre-feet of water.

Capay reservoir on lower Cache Creek would have a storage capacity of 378,000 acre-feet. The total seasonal irrigation yield would be 155,000 acre-feet of water.

Monticello reservoir on Putah Creek west of Winters would have a storage capacity of 130,000 acre-feet and develop a total seasonal irrigation yield of 96,000 acre-feet of water.

Nashville reservoir on the Cosumnes River north of Plymouth would have a storage capacity of 281,000 acre-feet. It would be operated for irrigation and flood control providing a total seasonal irrigation yield of 163,000 acre-feet of water.

(Continued on page 25)

Improvements in the Gilroy Area

By H. S. PAYSON, Resident Engineer

THE Division of Highways has recently completed a general improvement to the highway system on Route 2, the San Francisco-Los Angeles Coast Highway, in the vicinity of Gilroy, in Santa Clara and San Benito counties.

Three contracts were let by the Department of Public Works to effect the improvements. Two of these contracts were planned and administered by District IV, Division of Highways, Jno. H. Skeggs, District Engineer, and the third by the Bridge Department under F. W Panhorst, Bridge Engineer. A previous article in the "California Highways and Public Works," August 1941, issue, described some phases of this work.

SOUTH OF GILROY

Two concurrent projects south of Gilroy were executed, extending from the Sargent Overhead over the main line of the Southern Pacific to the Prunedale Junction in San Benito County. These projects consisted of a relocation and improvement to the highway and the construction of a new bridge over the Pajaro River. This local improvement constitutes a much needed realignment to the old, winding roadway that crossed the Pajaro River on sharp alignment at Sargent Station, 6 miles south of Gilroy. The completed improvement provides four lanes of divided highway and bridge on high standards at a most opportune time for use in the strategic network of highways for the National defense.

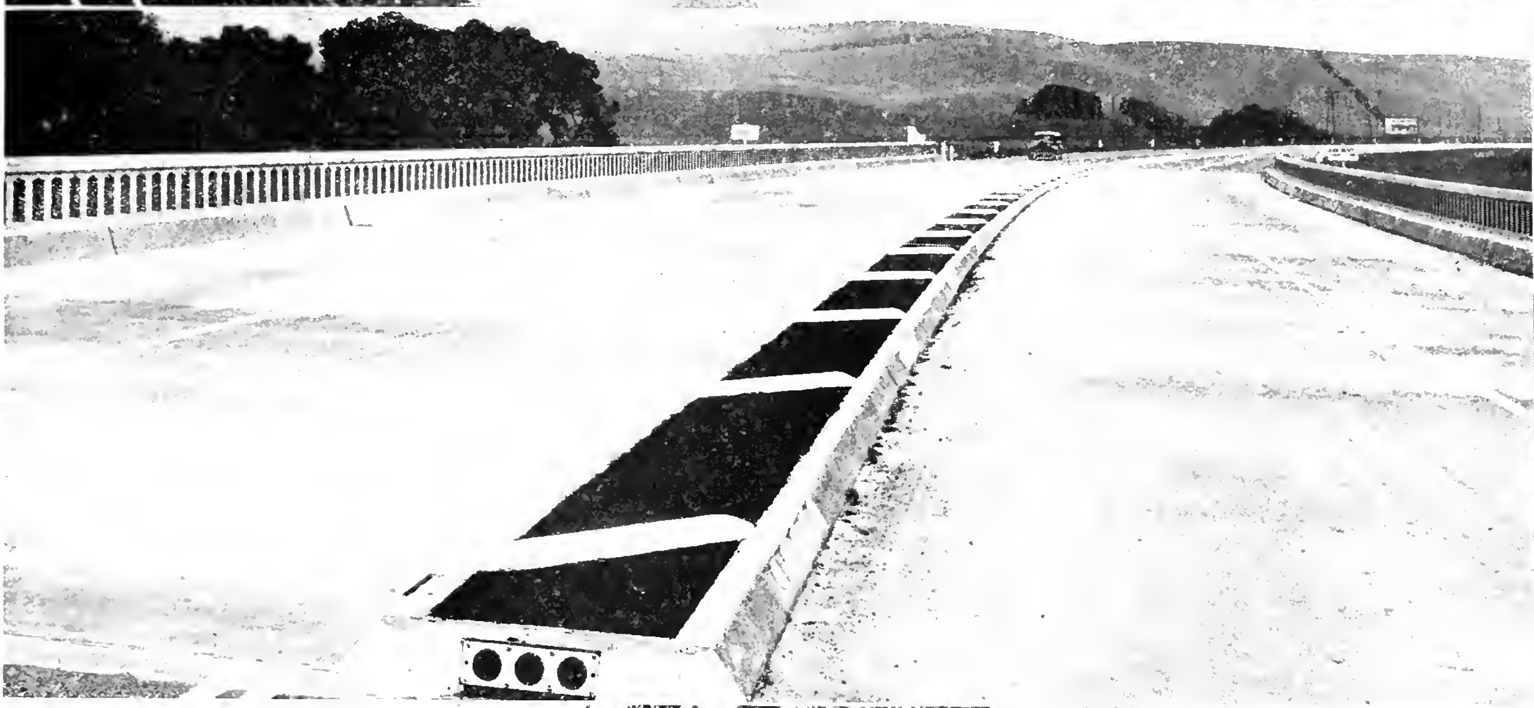
The total length of this project is 2.6 miles.

HISTORY OF NEW LOCATION

The importance of this section of highway and its natural value of location has been demonstrated repeatedly since the earliest history of transportation in California. Early Mission travel followed this location extensively, while early American travelers followed the Spanish and Californian. This traffic found the location convenient and useful, crossing the Pajaro River and the San Benito River on horseback without bridges. As the flow of traffic increased and the transportation of heavier shipments assumed greater importance it became necessary to provide better highway and bridge facilities.

A ferry was operated for many years across the Pajaro River below the mouth of the San Benito River during periods of flow in the former. Old residents of the area still recall stories of the difficulties, dangers and occasional drownings that followed in the use of the ferry. During dry periods the travel ordinarily reverted to a location some three miles upstream from the ferry, at the location of the present highway. Heavy

Typical new roadway on U. S. 101 north of Pajaro River in Santa Clara County near Sargent



Upper—Antiquated bridge across Pajaro River at Sargent which has been replaced by new structure shown in lower photograph
Center—Raised division strip on deck of new bridge contrasting with narrow roadway on old span

View of stretch of new divided highway on U. S. 101 at Sargent in Santa Clara County

horse-drawn stages were unable to use the ferry, and elected to ford the river near the new bridge site, often being delayed or mired down for days in wet weather.

It appears that a small timber bridge was built, crossing the Pajaro River near the present crossing, about 1860, operated as a private toll bridge for many years. It is said the revenue from the tolls was used to maintain both the bridge and keeper, and a sporting club and bar at the north bridgehead for the pleasure of local residents and travelers.

LONG STUDIES MADE

About 1871 this bridge was replaced with a timber structure having three timber truss spans on pile bents with short approach spans to a gravelled roadway. This bridge remained in place until the high water of 1937-38, long after its use was abandoned.

In 1911 a 200-ft. steel truss span bridge was built by the counties about 600 feet downstream from the timber bridges described. This structure served as a unit of the new concrete pavement constructed by the newly formed State Highway Department. This bridge and highway have been used by the public until the completion of the new highway projects described by this article.

Studies for the location of the improvement of the route were made over a period of several years, and developed two principal alternates. The first struck boldly over the rolling hills of the old Sargent Ranch to a new crossing of the river downstream from the steel bridge, and contained a new overhead over the railroad, a short, high embankment approach to the river crossing, and crossed a long, marshy area. This location would have required new right of way, extensive sidehill excavation in wet, unstable ground, and many undesirable features from a maintenance standpoint. The other alternate, the adopted alignment, followed a portion of the old roadway, utilized a portion of the existing overhead over the railroad, and permitted easier construction in fairly stable material, while adding but little length to the first location studied.

CONSTRUCTION DETAILS

The new highway construction provided a graded roadway width of 66 feet; two 23-foot roadways separated by a 6-foot median area, and having 7-foot shoulders. Transition areas from this section to existing pavement were provided at either end of the project. The surfaced area was composed of 10 inches of select material, 5 inches of imported borrow, and 3 inches of plant-mixed surfacing. The shoulders were surfaced with road-mixed surfacing.

The full section alignment permits observed operating speeds up to 75 miles per hour without difficulty.

The new bridge crossing the Pajaro River is located approximately halfway between the old steel truss bridge and the location of the former timber structures. The four bridges used to cross the river at this location have all been located within a space some 600 feet, showing the natu of the terrain.

UNUSUAL CONSTRUCTION FEATURES

The newly completed structure composed of two high concrete abu ments and three concrete pier founded on piles or hard foundati strata. The superstructure is form by four lines of continuous steel pla girders, restrained for dead and li loads by the piers. A reinforc concrete deck provided two 25-fo roadways divided by a 4-foot curbin Wide outer curbs are provided wi concrete railings.

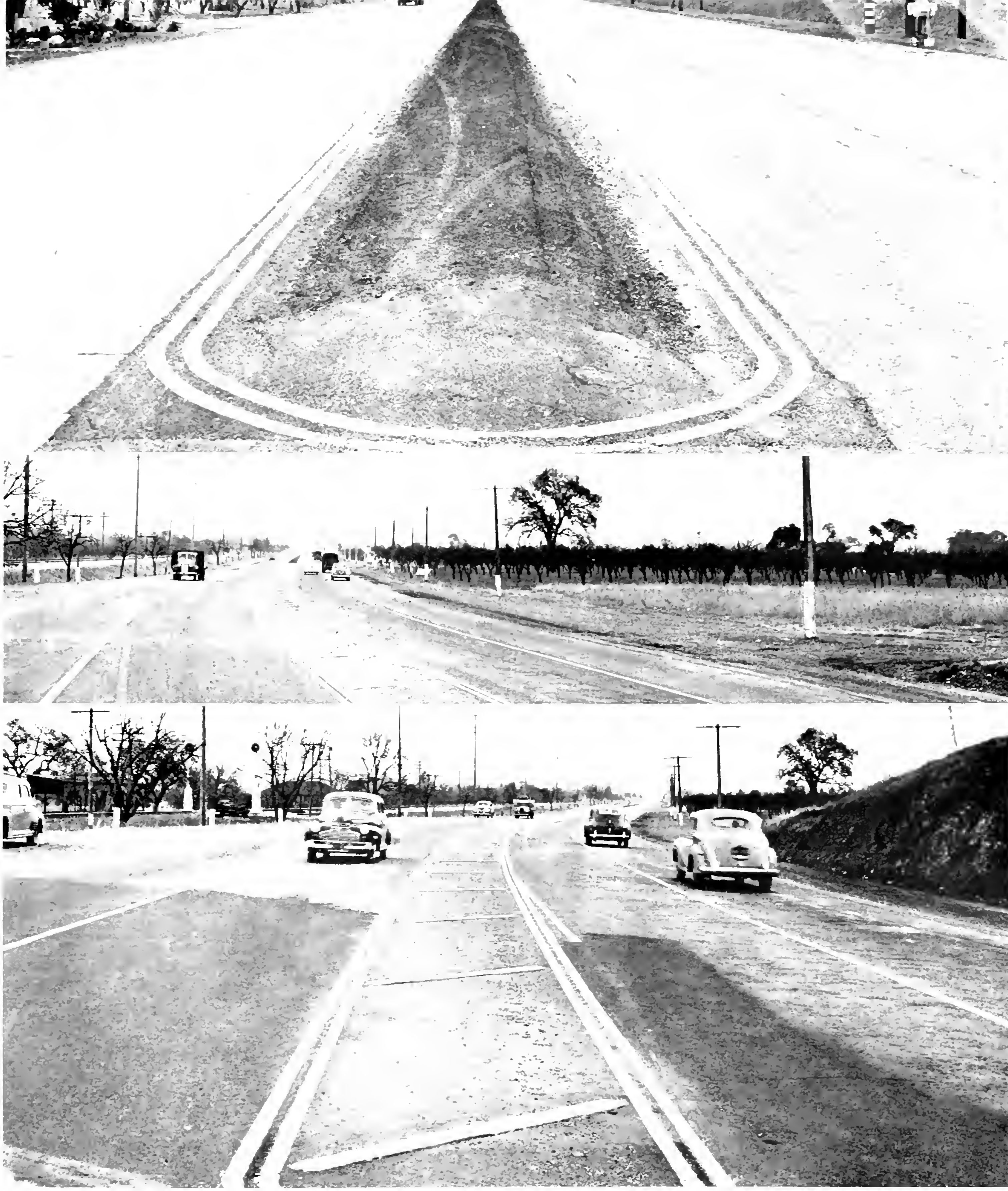
Many unusual construction featur were used to construct this bridg owing to lack of heavy equipme and select crews, both in deman on defense work. Probably the mo unusual on a bridge of this size w that of erecting the steel over th river, shown in the August issue this magazine, wherein that portion shown being handled from rafts floa ing the heavy members on the wate

The construction of these two pro ects occupied a full year from Noven ber 1940.

The old two-lane pavement nort of Gilroy to the existing three-lan pavement at Llagas Creek, a distan of 5.64 miles, was improved unde another contract during this san period.

A new roadway was graded o alignment west of and paralleling th existing pavement, separated fro the old roadway by a raised media area 10 feet wide. The new roadwa

(Continued on page 21)



These photographs show types of divided highway construction on new improvement on U. S. 101, north of Gilroy

DESIGNATED MILITARY AND NAVAL ACCESS ROADS FO[R]
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Post	County-Route-Section	Location	Length	Total cost (including construction, engineering and right of way)	Status of plans
District I					
Eureka Section Base	I-Humboldt-Feeder	Rte. 1 near Arcata to Eureka Section Base	12 6	$500,000	County preparing plans
District III					
McClellan Field Sacto. Air Depot	III-Sacramento-Feeder	Ben Ali to S.P. Underpass	3 0	160,000	County preparing plans
	III-Sacramento-Feeder	Along northerly boundary	1 5	----	Cost estimate not available
Mather Field	III-Sacramento-Feeder	Mather Field to Mills	1 3	55,000	County preparing plans
District IV					
Hamilton Field	IV-Marin-1-A	Channelization at Entrance		----	Cost estimate not available
	IV-Marin-Feeder	Various Roads in Reservation	3 3	90,000	Plans completed
Alameda Air Base	IV-Alameda-Feeder	Estuary Tube	1 1	6,730,000	Design suspended pending financing of construction
Moffett Field	IV-Santa Clara-68-A	Pedestrian Underpass at Moffett Blvd.		19,300	Design completed
	IV-Santa Clara-Feeder	Improvement Moffett Blvd.	0 2	8,900	Construction completed by WPA except for sidewalk
Camp McQuaide	IV-Santa Cruz-Feeder	Beach Road from Watsonville to San Andres Road	2 5	85,000	Construction completed by WPA
	IV-Santa Cruz-Feeder	San Andres Road from Beach Road to San Andres School	3 3	144,200	Plans complete. WPA to construct
Camp McQuaide	IV-Santa Cruz-Feeder	San Andres Road from San Andres School to Aptos	5 2	37,800	Plans nearly complete
	IV-Santa Cruz-Feeder	San Andres Road to New State Route 56	1 5	255,000	Survey deferred
	IV-Monterey-Santa Cruz 56-D, J	Watsonville Airport to Beach Rd.	2 0	448,700	Survey in progress
		Pajaro River Bridge		123,200	
Moore Dry Dock & Defense Plant Corp.	IV-Alameda-Feeder	Adeline St. Separation		277,000	Plans completed. Contract awarded by Navy
Richmond & Todd-Calif. Shipyards Richmond	IV-Contra Costa-Feeder	Pullman and Panhandle Blvds.	1 5	247,000	All estimates by PRA. No surveys at present
		14th St.	0 8	105,000	
		Herman Ave.	0 5	104,000	
		R.R. Separation Cutting and Pullman		533,000	
Treasure Island		Approach Road from Bay Bridge	0 6	227,500	Plans by PRA
San Francisco Harbor Defense		Various Roads			Cost estimate not available. Plans by PRA
District V					
Fort Ord	V-Monterey-Feeder	East Garrison to Rte. 118	4 6	863,000	Survey not completed
		Salinas River Bridge		754,000	Plans completed
	V-Monterey-Feeder	Rte. 118 to Rte. 2 North of Salinas	2 5		Cost estimate not available. Surveys deferred at request of Army authorities
	V-Monterey-Feeder	Grade Separation at Rte. 118 and Railroad			
	V-Monterey-Feeder	Stub Connection to Railroad	0 9		
	V-Monterey-Feeder	Rte. 117 to Ft. Ord near Laguna Seca	1 54	74,800	Plans turned over to Army April 24, 1941
	V-Monterey-Feeder	Del Monte Ave., from Monterey to Seaside Junction	2 8	450,000	Surveys being deferred pending development of project
	V-Monterey-Feeder	East Garrison-Route 118 Road to Route 2 South of Salinas	3 4	397,500	Survey complete
	V-Monterey-Feeder	Rte. 2 South of Salinas to Salinas Airport	1 40	167,500	Survey complete
	V-Monterey-56-1	Rte. 117 to Seaside Junction	2 9	502,000	Plans completed
		Seaside Junction to Marina	6 3	824,000	Plans completed
		Fort Ord Pedestrian Overcrossing		38,500	Plans completed
		Fort Ord Pedestrian Undercrossing		49,500	
		Marina to Castroville	5 3	580,000	Plans completed
		Neponset Bridge		424,000	Plans completed
		Lapis Underpass		198,000	Design nearly complete
		Tembladero Slough		22,000	Plans completed

/HICH SURVEYS AND PLANS ARE BEING SUPERVISED BY OADS ADMINISTRATION

Post	County-Route-Section	Location	Length	Total cost (including construction, engineering and right of way)	Status of plans
District V—Continued					
Fort Ord—Continued	V-Monterey-22-A	Castroville to Rte. 2	5.2	$528,000	Plans completed
		Castroville Overhead		61,500	Plans completed
Camp Hunter Liggett	V-Monterey-Feeder	King City to North Reservation Boundary	13.0	722,500	Plans nearly complete
		Pine Creek Bridge		38,500	
	V-Monterey-Feeder	North Reservation Boundary to Jolon	5.5	269,500	WPA construction. Work started July 14, 1941
	V-Monterey-Feeder	Jolon to East Reservation Boundary	3.5	176,000	WPA construction. Work started May 7, 1941
		Jolon Creek Bridge		33,800	Plans completed
	V-Monterey-Feeder	East Reservation Boundary to Hames Valley School	13.1	652,000	Plans completed
	V-Monterey-Feeder	Hames Valley School to Hames Creek Bridge	5.9	343,300	Plans completed
	V-Monterey-Feeder	Jolon to Rte. 56	28.6	2,414,600	Design complete 11.2 miles. Balance deferred until construction assured. Plans by PRA
Camp San Luis Obispo	V-San Luis Obispo-56-D	San Luis Obispo to 0.5 mile West of Pennington Creek	6.4	1,757,000	WPA started construction April 8, 1941
		Chorro Creek Overhead		315,000	
Camp Cooke (Santa Maria-Lompoc)		Various Roads			Cost estimate not available. Plans by PRA
District VI					
Lemoore Basic Flying School	VI-Kings-10-B, C	Improvement of State Rte. 10 from Lemoore to West Boundary Flying School			Degree of improvement not yet determined
District VII					
Terminal Island (Los Angeles Harbor)	VII-Los Angeles-Feeder	Seaside Blvd. to Willow St.	3.0		
		Grade		1,546,000	Plans nearly complete
		Pave		510,000	
	VII-Los Angeles-Feeder	U. P. R.R. Separation Seaside Blvd.		266,000	Plans completed
		Cerritos Channel Bridge		3,950,000	Plans completed
		Anaheim St. Overhead State St. Overhead		1,211,000	Plans completed
District VIII					
March Field and Camp Haan	VIII-Riverside-19-B, C	Riverside to East End Box Springs Overhead	3.8	563,700	Plans completed
		Box Springs OH Widening		23,100	Plans completed
	VIII-Riverside-19, 78-C, D	East End Box Springs Overhead to Dracaea Ave. (includes Separation Rtes. 19 and 78)	1.0	165,000	Plans completed
	VIII-Riverside-78-D	3 miles South of March Field to Dracaea Ave.	4.9	626,600	Plans completed
	VIII-Riverside-Feeder	Iowa Ave. from Rte. 19 to Rte. 43	3.1	243,800	Plans completed
District IX					
Muroc Bombing Range	IX-Kern, San Bernardino-Feeder	Rte. 145 South of Kramer to West Cantonment Area near Muroc	23.8	475,500	Deferred at Army request when Preliminary Engineering nearly completed. Access road may be required on different routing
District X					
Benicia Arsenal	X-Solano-74-B	0.5 mile East of Vallejo (Rte. 7) to Benicia Arsenal	7.0	665,000	Plans completed
	X-Solano-74-C	Benicia to 3.2 miles Northerly. (Includes Sulphur Springs Valley Creek Bridge)	3.9	308,300	Plans completed

DESIGNATED MILITARY AND NAVAL ACCESS HIGHWAYS—Continued

Post	County-Route-Section	Location	Length	Total cost (including construction, engineering and right of way)	Status of plans
District X Continued					
Mare Island Navy Yard	X-Solano-Feeder	Extension Ryder St. in Vallejo			Cost estimate not available pending further data from Navy
	X-Solano-Feeder	Extension Railroad Ave. on Mare Island	0 8	$69,300	Plans completed
Stockton Air Base	X-San Joaquin-Feeder	Sharps Lane, from Stockton Air Base to Charter Way			Cost estimate not available. County preparing plans
District XI					
San Diego Area	XI-San Diego-2-S.D	Market St. to Couts St.	2 8	449,000	Plans completed
	XI-San Diego-2-S.D	Couts St. to Enterprise St. (including Barnett and Witherby Separations)	0 4	945,000	Plans completed
	XI-San Diego-2-S.D	Enterprise St. to Mission Bay Park	2 0	364,500	Plans completed
		Widen Bridges across San Diego River, Tecolate and Cudahy Creeks		176,000	Plans completed
Camp Callan	XI-San Diego-2-S.D	Grade Separation and Approaches at North Entrance	0 55	77,000	Plans completed
San Diego Area	XI-San Diego-12-S.D	Lytton St. and Barnett Ave. from Rosecrans St. to Rte. 2	1 0	218,200	Plans completed
	XI-San Diego-77-S.D	"A" St. to Mission Valley Rd.	3 0	1,695,000	Plans completed
		Grade Separation Structures at Date St.		88,000	Plans nearly complete
		Quince St.		71,500	Plans nearly complete
		Richmond St.		60,500	Plans nearly complete
		Upas St. (Equestrian and Pedestrian)		27,500	Plans nearly complete
		University Ave.		240,000	Plans completed
		Pascoe St.		55,000	Plans nearly complete
		Sixth St.		93,500	Plans nearly complete
	XI-San Diego-77-S.D., A	Mission Valley Rd. to 0.5 mile North of City Limits	4 0	968,000	Plans completed
		San Diego River Bridge		364,000	Plans completed
		Friars Rd. Separation		22,000	Plans completed
		Kearney Mesa Housing Separation		25,000	Plans completed
	XI-San Diego-Feeder	Rosecrans St. to Lytton St. to Rte. 2		272,500	Survey in progress
		Highway and Railroad Separation at Rte. 2		590,000	Design in progress
		Mission Valley Rd., Rte. 2 to Rte. 77		390,000	Survey in progress
	XI-San Diego-Feeder	Harbor Drive, 8th St. in National City to Civic Center	5 2	605,000	
		Harbor Drive, Approaches to Housing Project	0 5	15,400	
		Schley St. Separation		630,000	Survey and design in progress
		Switzer Canyon Separation		630,000	
		7th St. Channel Br.		49,500	
		Chollas Cr. Br.		99,000	
		Harbor Drive, Civic Center to Talbot	4 3	680,000	
		Small Boat Channel Bridge		320,000	
Fallbrook	XI-San Diego-Feeder	Fallbrook Arsenal to Rte. 77	1 0	49,000	Plans completed
Naval Arsenal	XI-San Diego-195, 77-A, D	Rte. 2 to Jct. Rte. 77 and Arsenal Road (portions)	4 56	400,000	Reconnaissance completed
North Island Naval Air Station	XI-San Diego-199-A	North Island Naval Air Station to Rte. 2	13 3	611,000	Preliminary engineering deferred pending construction funds becoming available
Fort Rosecrans	XI-San Diego-Feeder	In Fort Rosecrans, from Ballast Point to Upper Cantonment	2 37	272,269	Army contract. Work started July 25, 1941
Camp Lockett	XI-San Diego-200-D	Campo Creek, Bridge and Approaches		17,600	Design in progress

VISITORS RESTRICTED AT SHASTA DAM BY WAR

United States Bureau of Reclamation announced certain construction areas of Central Valley Project are closed to the public, but that visitors are permitted at vista houses at Shasta and Friant dams. No passes of any sort are required to view the spectacular construction work from these special vantage points which attracted more than half a million visitors to these dams last year.

Since the outbreak of war additional armed guards have been employed on all divisions of the project, and extra precautions are being taken in the hiring of new employees and in maintaining close surveillance of every phase of work on the huge water and power project.

Reckless Drivers Make Life of Highway Surveyor Dangerous

(Continued from page 9)

telescope he notices that a car has stopped beside this flagman. He is probably asking whether or not this is the road to Oshkosh. Another motorist is forced to the opposite lane. He sees, for the first time, the men working on the pavement, but it is too late. Another car is approaching him, and he must return to his own lane. He passes to the left of the head chainman, but the other car does not slacken its speed. He must cut in between the two men, and does. Snap! The tape is broken and the men move off the pavement to make repairs.

Does this story sound fantastic? Well, it isn't. These things are happening continuously. Why there aren't more serious accidents is an unanswered question. These workmen must constantly be alert. One of the wisest comments to be made by one of these men to a newcomer is: "Get used to traffic? You mustn't get used to it, for if you do, you'll be killed."

It is probably safe to say that the majority of the motorists are not intentional offenders. Most certainly there are many, many car drivers who are very courteous. It is that small group of drivers who have utter disregard for the safety of others who must be taken to task.

THOUGHTLESS DRIVERS

These beings have the attitude of a small boy with a chip on his shoulder. He figures he has paid his portion for the use of the highways through gasoline tax and he is thereby privileged to do as he pleases. "I'm the guy who pays your wages," he thinks. "Make way for the master! If you don't like it, what are you going to do about it?"

Little does this man realize that these false motions of the workmen, forced upon them by others like himself, are actually costing the motoring public money which might be placed into more highways. This is particularly true in cases where maintenance crews are working on pavement. The sooner he learns that a flagman is there for his protection alone, and not to create a nuisance, the better for everybody.

Another great contributing factor in this case is ignorance and thoughtlessness. Many motorists do not realize the danger to which these workmen are daily subjected. They do not realize that there might not be any room for a man to move away, if he should find an automobile too close for safety. They seem to forget that there are other motorists on whose account these men must be alert.

Above all, they should realize that signs are placed upon the highways for a reason. The "Men and Equipment Working" signs are painted on a yellow background, and yellow means "Caution." The situation ahead of these signs might not always be dangerous, but it doesn't pay to take a chance. A dead man or a broken piece of equipment is useless on highway work.

Niles Canyon Improvement Nearing Completion

(Continued from page 12)

structed on the north side of main highway. It is more or less a tangent extension of the old route from the point where it formerly curved to cross Southern Pacific tracks to a point opposite the beginning of service road into Sunol. These two service roads and the main highway, at intersection point, are divided by a traffic island two feet wide and 200 feet long. At east end of Sunol, the existing approach constructed as part of Arroyo de la Laguna Creek Bridge Contract was revamped to care for traffic entering or leaving town from that side.

All main highways, except for the subway and the service roads, are surfaced with plant mixed surfacing. The main highway surfacing is 22 feet wide with 7-foot shoulders treated with penetration oil.

The $135,000 contract for this work was let by the State under authority of the Public Roads Administration to Earl W. Heple of San Jose. The total cost to the State of the project, including all railroad work, will be approximately $152,500.

Improvements in the Gilroy Area

(Continued from page 16)

was paved 23 feet wide, of standard Class "B" concrete pavement, for the exclusive use of southbound traffic. The westerly half of the old pavement was surfaced with a 10-foot wedge of asphaltic pavement to eliminate the old roadway crown, and now provides two 10-foot traffic lanes for north bound traffic.

Plant-mixed surface borders were placed on each side of the new pavement and on the west side of the old roadway, while the raised area between was treated with penetration oil treatment. Road connections were provided between the roadways at county road connections, paved with asphaltic concrete. The connections at the Gilroy city limits and at the Llagas Creek Bridge provide transitions to existing pavement with suitable dividing areas and median bars.

A supplemental contract was let by the City of Gilroy to provide better connection with their streets and the widened State highway. The completed project is of a high character and relieves an intolerable situation between Gilroy and San Jose. The completed roadway provides fast, smooth surfacing for traffic.

The completion of these three projects has eliminated two dangerous portions of roadway and provides a much needed improvement of high quality and standards. The remaining portion between Gilroy and the Sargent Overhead, approximately 5 miles in distance, was originally scheduled for early reconstruction, but may have to be postponed because of the national emergency. The three projects were constructed by:

Contract	*Contractor*	*Amount*
24TC7	N. M. Ball Sons (North Gilroy)	$184,000
24TC9	Heafey-Moore Co. & Fredrickson & Watson Const. Co. (South of Gilroy)	135,000
214TC17	C. W. Coletti & Co. (Bridge)	127,000
	Total contract cost	$446,000

The writer served as Resident Engineer for the two roadway contracts, while I. T. Johnson was Resident Engineer for the new bridge over Pajaro River.

Scene on Echo Summit after snow removal operations. Depth of snow pack is clearly shown in this picture

Snow Removal on Echo Summit

By N. R. BANGERT, Assistant Maintenance Engineer

THE first heavy snowfall of the season came to the high Sierra region, east of Sacramento, during the Christmas and New Year holiday period. This storm served to christen the new snow removal station of the Division of Highways located at Echo Summit on U. S. Highway 50 and the new snow removal equipment obtained especially for this work.

Prior to this season only push plow equipment was assigned to snow removal work on this road and the road generally closed shortly after the first heavy storm each winter. On August 29th of this year the California Highway Commission voted funds for the purpose of keeping the Echo Summit road open throughout the winter. This authorization provided for the purchase of the necessary additional snow removal equipment, and housing facilities for both men and equipment.

Orders were placed at once for equipment which included, in addition to push plows and light trucks, two large auger type snowplows. Clearing operations at the new maintenance station site were started on September 3d and the first construction materials arrived on the job September 5th. As rapidly as materials were received workmen were assigned to the project to carry out the erection of the station buildings, which included a 40-foot by 107-foot truck shed, a gasoline and oil storage house, a bunk house capable of housing about 30 men, and a boiler house for supplying steam heat to both the truck shed and the living quarters. During the peak period of construction about 40 carpenters, electricians, steam fitters, painters, and others were employed. It was necessary to dig a well and develop a suitable water supply, also to place various large fuel storage tanks underground, and to construct a sewage disposal system. The installation of an electric generating plant was required as no commercial power was available in the vicinity.

All major buildings were sufficiently complete by the end of November to permit their use and finishing touches on the interiors of the buildings were completed by about December 20th.

In view of the difficulties experienced in obtaining materials and the isolated location of the work, an exceptional job was done by the personnel of District III and Headquarters Shop.

Judging from experience during the heavy storms of the holiday period, the equipment assigned to this station and the facilities provided appear ample to handle the snow removal work on this trans-Sierra highway. Recent storms have also indicated that the snowfall on the

Echo Summit road will be equal to, if not greater than that on the Donner Summit highway.

The following figures represent the snow pack at the two summits during the recent storm period:

	Echo Summit Inches	Donner Summit Inches
December 17, 1941	20	10
December 18, 1941	20	24
December 19, 1941	16	14
December 21, 1941	21	18
December 23, 1941	22	26
December 24, 1941	29	24
December 26, 1941	28	26
December 29, 1941	51	49
December 30, 1941	73	53
December 31, 1941	85	80
January 2, 1942	73	70

NOTHING IRREGULAR

In the wild and wooly West a poker game was in progress. A tenderfoot, looking on, saw one of the players deal himself four aces from the bottom of the deck. The tenderfoot whispered indignantly to another onlooker. "Did you see that?"

"What?"

"That swindler dealt himself four aces."

"Wall, it was his deal, wasn't it?"

"Aren't your neighbors honest, Uncle John?"

"Oh yes, all of them."

"Then why do you keep that loaded shotgun near your henhouse?"

"That's to keep 'em honest."

Upper—New maintenance station of Division of Highways on Echo Summit
Lower—View on U. S. 50 west of summit

Looking north over completed portion of Ducor Cutoff. Bridge in background is over Poso Creek

View looking south over section of highway built by State from point a half mile south of Poso Creek

Another Link Under Way On Ducor Cutoff

WORK has been commenced on another link of the Ducor Cutoff. The contract calls for grading the roadway and a light penetration oil treatment, from Deepwell Ranch to one quarter mile north of the Kern-Tulare County Line, a distance of about eight miles.

Due to an advance in prices, the work contemplated under the original budget item could not be accomplished. As a result several thousand cubic yards of imported borrow material and an adequate road surface will have to be provided at some future time, to complete this 8-mile stretch of highway.

The recently completed 5.6-mile stretch of the new Ducor Cutoff extending southerly from Deepwell Ranch to the Famoso-Woody Road was completed to modern standards, including the surfacing.

To date the Ducor Cutoff has been a road of "links." The first link, built by the State extending southerly from Ducor to Thermal School in Tulare County, provided for grading and the construction of a bridge at White River. This link has yet to be provided with surfacing before it can be considered complete.

The next link, a 1.2-mile stretch of highway, involving heavy excavation, the grading for which was completed by Tulare County and the State provided an oil treated surface to the roadway.

Kern County provided still another link when Supervisor W. R. Woollomes graded and oiled 3½ miles of highway between Poso Creek and the Famoso-Woody Road. Then the State, by another contract, extended the cutoff from Poso Creek to a point 3.3 miles further to the south, this latter stretch being graded and surfaced to modern standards.

With the completion of the present Louis Biasotti & Son contract, it will then be possible, weather permitting, to drive from Bakersfield via Oildale to Ducor, over the cutoff. The highway along this route, however, will still be far from complete. There will still remain a 3.6-mile link, now a narrow rolling Tulare County road without oil, to be completed.

Water Plan Development Will Aid Two Great Valleys

(Continued from page 13)

Ione reservoir on Dry Creek would have a storage capacity of 610,000 acre-feet. It would be operated for irrigation and flood control developing a total seasonal irrigation yield of 150,000 acre-feet.

Pardee reservoir on the Mokelumne River four miles north of Valley Springs, a part of the State Water Plan, is already developed by the East Bay Municipal Utility District. It is operated for municipal water supply and power development.

IN SAN JOAQUIN VALLEY AREA

Valley Springs reservoir on Calaveras River three miles south of Valley Springs would supplant the present development of the City of Shasta and have a storage capacity of 325,000 acre-feet for flood control and irrigation. It would develop a total seasonal irrigation yield of 98,000 acre-feet of water.

Melones reservoir on the Stanislaus River six miles west of Jamestown would supplant the present development of the South San Joaquin and Oakdale Irrigation Districts. The proposed reservoir would have a storage capacity of 1,090,000 acre-feet. It would be operated for irrigation, flood control and power development. Installed capacity of power plant would be 68,000 kilovolt amperes. Operated primarily for irrigation and flood control with incidental power development the total seasonal irrigation yield would be 887,000 acre-feet. Average annual output in electric energy would be 240,000,000 kilowatt hours.

DON PEDRO RESERVOIR

Don Pedro reservoir on the Tuolumne River five miles northeast of La Grange would have a storage capacity of 1,000,000 acre-feet and would replace the present dam and reservoir of the Modesto and Turlock Irrigation Districts. The reservoir would be operated for irrigation, flood control and power development. Installed capacity of the power plant would be 120,000 kilovolt amperes. Operated primarily for irrigation and flood control with incidental power development the reservoir would provide a total seasonal irrigation yield of 1,303,000 acre-feet and develop an estimated annual output of electric energy of 365,000,000 kilowatt hours.

Exchequer reservoir on the Merced River, located seven miles above Merced Falls, is already developed by the Merced Irrigation District. It has a storage capacity of 279,000 acre-feet and is operated for irrigation, flood control and power development.

Buchanan reservoir on the Chowchilla River west of Raymond would have a storage capacity of 84,000 acre-feet operated for irrigation and flood control. The total seasonal irrigation yield would be 53,000 acre-feet.

Windy Gap reservoir on Fresno River 32 miles northeast of Madera would have a storage capacity of 62,000 acre-feet. It would be operated for irrigation and flood control. It would develop a total seasonal irrigation yield of 45,000 acre-feet.

Pine Flat reservoir on the Kings River 26 miles east of Fresno would have a storage capacity of 400,000 acre-feet. The reservoir would be operated for irrigation, flood control and power development. Installed capacity of the power plant would be 40,000 kilovolt amperes. Operated primarily for irrigation and flood control with incidental power development the reservoir would produce a total seasonal irrigation yield of 1,764,000 acre-feet and an estimated annual output of electric energy of 100,500,000 kilowatt hours.

Pleasant Valley reservoir on the Tula River nine miles east of Porterville would have a storage capacity of 39,000 acre-feet, operated for irrigation and flood control. It would develop a total seasonal irrigation yield of 128,000 acre-feet.

Isabella reservoir on the Kern River, 35 miles northeast of Bakersfield, would have a storage capacity of 338,000 acre-feet, operated for irrigation and flood control. It would develop a total seasonal irrigation yield of 670,000 acre-feet.

Motor Transport of Tomorrow Will Be Big Post-war Problem

(Continued from page 7)

There is no mystery, of course, in highway accident reduction. The time-proven formula of education, enforcement and engineering is just as effective and just as certain of results today as it ever was. But the task of applying the formula is more difficult.

FIELD OF EDUCATION

In the field of education, for example, the public has become less receptive because psychologically we are facing an eat-drink-and-be-merry attitude on the part of millions of Americans who are enjoying substantial increases in income.

In addition, war news is crowding safety news off the front pages and off the air waves. Europe's shooting war is more dramatic than a war on accidents. There is less room in headlines and broadcasts for news about saving lives while lives are being snuffed out in battles on land and sea and in the air.

There are also difficulties in the enforcement program. The State officials charged with the duty of enforcing traffic regulations have lost large numbers of their most competent men to the armed services. High wages being paid by industry act as magnets to draw away from the enforcement agencies the capable recruits who might otherwise become replacements.

Large expenditures required for defense purposes have also made difficult the procurement of appropriations necessary for increasing the volume of enforcement activity to match the increased volume of traffic and the consequent increased accident exposure.

ENGINEERING SIDE

On the engineering side of the safety picture, I don't need to tell you gentlemen of the inroads which the defense effort has made in your own personnel. The demand for competent traffic engineers far exceeds the supply.

Nor do I need to tell you that the funds necessary for highway construction and maintenance are in many cases hard to obtain. It will be no easy task to provide even the stop-gap facilities urgently needed in the defense areas. Complete utilization of all funds available for construction and maintenance will be called for.

Yet despite all of these obstacles—and because of them—the agencies promoting the cause of highway safety have redoubled their efforts. The President in a proclamation has called upon the National Safety Council, and all citizens and other interested organizations, for a concerted and intensified campaign against accidents. The President pointed out that accidents, by taking a huge toll in life and property, definitely hinder the country's national defense effort.

Speaking for all of the agencies with which the Automotive Safety Foundation is working, I can assure you gentlemen that there is a clear recognition of the problem on their part, and a determination to intensify their activities.

IMMEDIATE JOB

We face one more immediate job. And that is planning for the post-defense period.

No well-informed person can question the fact that a huge road-building program is in prospect. If the emergency had not intervened, that program would now be under way, for even the peace-time demands in motor transportation revealed in glaring manner the inadequacies of our present highway system. Highway construction is almost automatically No. 1 on the list of post-defense projects, as the President has recognized in the creation of a National Highway Planning Board, headed by Mr. MacDonald and comprising, among others, engineers who are here tonight.

The prospect is further supported by general recognition that there will be need for substantial public works to take up the slack in employment when defense activities are ended.

In planning for that period, we must strip from our legal processes all of those long-enduring and costly delays in procurement of rights-of-way which, left to the post-defense period, would confront us inevitably with dangerous barriers to a great forward reemployment program on needed public roads.

ACTION NEEDED NOW

We also must evolve policies of finance which will not cripple the individual or the Nation as a whole, but which instead will enable us to carry forward this great program without undue hardship or sacrifice. Wise use of the large sums of special taxes now paid by motorists will largely accomplish that purpose.

Both problems, legal and financial, call for action—NOW. They pose many difficult and complicated issues, which must be resolved if we are to be ready, when war production suddenly ends, to move swiftly and effectively into the kind of large-scale program which the Nation has a right to expect from its great corps of highway engineers.

Yet even if both of these phases of the planning job are carried through successfully, there will remain three fundamental questions of policy. These, too, are of immediate concern.

First. Will full use be made of the surveys by the 48 States which produced the master plan for highway development?

MASTER PLAN

The "master plan" is a coordination on a National scale, by State and Federal authorities, of 48 State "master plans," each based on surveys of present and future traffic needs, and providing an orderly program for meeting those needs to the maximum degree possible.

As the expression of far-seeing men, the master plan is an accomplishment that pays tribute to the great leadership of Thomas H. MacDonald, of the Public Roads Administration, and of other Federal and State highway authorities. It stands as a symbol of intelligent, cooperative effort between State and Federal agencies in the development of long-range plans for projects in which both agencies have direct and important interests.

What are the actual traffic needs today? What does the evidence indicate the expanded needs of the future will be? How can we meet these needs, getting maximum returns from every dollar spent, and doing first things first? These are the basic questions that have been asked and answered in this magnificent record of long-range planning. The master plan in its final analysis can best be described, it seems to me, as being essentially the application of good common sense to a big job.

Question No. 2. Will the program be carried on by the Federal Government alone, or will the traditional Federal Aid system be continued?

FEDERAL AID

As Patrick Henry said of our political history, there is no way of judging the future except by the past. Before the advent of the motor vehicle, road building in America was a local and largely disorganized operation. Movement was limited.

With the development of flexible, personal highway travel, the narrowly limited horizons of millions of families were lifted. It was learned that the motor vehicle recognizes no boundary in its movement, township, county or State. Through its use, distance was eliminated. The old toll concept of road construction had to be discarded in order to make possible the development of coordinated thoroughfares adequate to meet the revolutionary potentialities of a great new form of transportation.

All of this experience is back of the Federal Aid principle. Supporting it also is the proven leadership of men like Senator Hayden and Representative Cartwright, acknowledged highway authorities in Congress, whose wise counsel and able generalship made possible much of the progress of the good roads movement.

By trial and error, the hard way, we came through the years to a recognition that on the basis of use, roads divide themselves into broad categories, affecting in turn the National, State and local interest. It was learned that the size of the task required that the several units of Government each have its own administrative sphere of activity. We discovered the wisdom of carefully balancing the responsibilities among the States and the Federal Government in accordance with a policy which has demonstrated itself to be desirable, effective and of public benefit.

MOTOR TRANSPORT OF FUTURE

It was a long step from the pick-and-shovel type of road program of 1900 to the development in recent years of the master plan for a network of highways which envisions the tremendous potentialities of motor transport of tomorrow.

To abandon the Federal Aid principle, which was the outgrowth of the experience, would be another long step—backwards.

Finally, Question No. 3. Will the program be carried forward on a sound business basis, with competitive bidding by private contractors, or will it become a gigantic relief project?

Many years ago the costs of highway construction became a major factor in the fiscal economy of the several States. While the job was a public responsibility, it became clear that only by preserving the competitive system in bidding and letting out the jobs on contract under Government specifications could we get the full return from every dollar spent.

Certainly, we have an obligation of the highest order to carry on these projects in the most efficient way possible, else the burden will be terrific.

WHEN WAR ENDS

There would not seem to be any question as to how we should answer the three questions I have raised.

And yet it is my reasoned guess at the moment that if all those who are interested in sound highway policy should stand idly by, the master plan for orderly road development will be ignored; the policy of Federal Aid will be superseded by a centralized Federal control, and road building will fall into the category of relief. We will slip back 40 years to the status of our pick-and-shovel road-building days before the motor vehicle.

This opinion is not the result of the belief that there are iniquitous forces at work, deliberately planning such an outcome. Not at all. Rather, it is based on considerations evoked from the outlook for the post-defense period.

War Has Slight Effect on Traffic on Three State-owned Toll Bridges

IN SPITE of the state of war which was forced upon the Nation early in December, the traffic on the three State-owned toll bridges held up well throughout the month. The records indicate a decrease below the traffic volume of the previous month but nevertheless showed a marked gain over December, 1940.

On the San Francisco-Oakland Bay Bridge, the daily average for December, 1941, was 52,901 vehicles, representing a decrease of 3,714 vehicles per day as compared with November, 1941, and an increase of 18 per cent over December, 1940. The Carquinez Bridge with an average of 13,221 vehicles per day showed an increase of nearly 50 per cent above the record of December, 1940. The daily average for November, 1941, was 14,265 vehicles. During December, 1941, an average of 625 vehicles daily used the Antioch Bridge, representing an increase of 49 per cent over December, 1940, and a decrease of 206 vehicles per day when compared with November, 1941.

The vehicular traffic on the San Francisco-Oakland Bay Bridge and the Carquinez and Antioch bridges for the month of December, 1941, is tabulated below.

	San Francisco-Oakland Bay Bridge	Carquinez Bridge	Antioch Bridge
Passenger autos and auto trailers	1,432,931	367,807	14,840
Motorcycles and tricars	3,061	619	7
Buses	46,692	6,259	198
Trucks and truck trailers	85,444	30,367	3,526
Others	71,795	4,803	803
Total vehicles	1,639,923	409,855	19,374

"Here, Tommy," said Mrs. Jones to her neighbor's little boy, "run along and put this parcel on the bus."

"Which bus?" asked the lad.

"Any bus," replied Mrs. Jones. "It's me husband's lunch, and he works in the lost property office."

Said the artist: "I'll give you five dollars if you let me paint you."

The old mountaineer shifted his tobacco from one cheek to the other and back again.

"It's easy money," said the artist.

"Thair hain't no question 'bout that," the mountaineer replied. "I wuz just a-wonderin' how I'd get the paint off afterwards."

Bids and Awards For December, 1941

ALAMEDA COUNTY—A storm drain to be constructed across State Route 5 and through the town of Niles. District IV, Route 5, Section C. Robert B. McNair, Oakland, $31,567; Dan Caputo, San Jose, $32,519; Lee J. Immel, Berkeley, $36,620. Contract awarded to McQuire & Hester, Oakland, $29,129.

HUMBOLDT COUNTY—Between Weott and 0.5 mile north, about 0.5 mile to be graded and surfaced with roadmix surfacing. District I, Route 1, Section C. Guerin Bros., So. San Francisco, $49,100; Mercer, Fraser Co., Eureka, $52,366. Contract awarded to J. L. Conner & Sons, Ukiah, $47,379.

KINGS COUNTY—Across Kings River, 1.0 mile west of Stratford, a reinforced concrete slab bridge to be constructed. District VI, Route 125, Section D. Dan Caputo, San Jose, $31,967; F. Fredenburg & G. Moriconi, So. San Francisco, $34,637; L. D. Tonn, Lodi, $34,945; Trewhitt-Shields & Fisher, Fresno, $37,361; Louis Biasotti & Son, Stockton, $38,819; F. Kaus, Stockton, $39,140. Contract awarded to Kiss Crane Service, Berkeley, $30,866.

LOS ANGELES COUNTY—Installation of traffic signal system at the intersection of Lakewood Blvd. and Carson St. District VII, Routes 168 and 178, Sections A.A. Pacific Union Marbelite Co., Los Angeles, $8,521. Contract awarded to Econolite Corp., Los Angeles, $8,344.

LOS ANGELES COUNTY—Between Macy Street and Indiana Street, about 2 miles in length, existing roadbed to be widened, portland cement concrete pavement and base to be constructed, asphalt concrete surfacing to be placed over existing pavement and new portland cement concrete base and plantmixed surfacing to be placed on road connections. District VII, Route 26, Section LA,D. J. E. Haddock, Ltd., Pasadena, $270,508; Griffith Co., Los Angeles, $299,686; United Concrete Pipe Co., Los Angeles, $333,417; Radich & Brown, Burbank, $379,853. Contract awarded to Nick Perscallo, Los Angeles, $225,745.

LOS ANGELES COUNTY—At Long Beach Traffic Circle, about 0.3 mile, portions of the roadway to be graded and paved with portland cement concrete, portions to be surfaced with portland cement concrete base and asphalt concrete pavement and portions to be surfaced with asphalt concrete. District VII, Route 60, Section L.Bch.F. J. E. Haddock, Ltd., Pasadena, $31,180; Ansco Construction Co., Inc., Long Beach, $31,507; Sully Miller Contracting Co., Long Beach, $32,850; Griffith Co., Los Angeles, $38,437. Contract awarded to Vido Kovacevich, South Gate, $30,524.

LOS ANGELES COUNTY—About 0.4 mile of grading between Centinela Avenue and Slauson Avenue, District VII, Route 158, Section B. Vido Kovacevich, South Gate, $12,960; Griffith Co., Los Angeles, $12,978; Roland T. Reynolds, Anaheim, $13,610. Contract awarded to Oswald Bros., Los Angeles, $12,542.

SOLANO COUNTY—Between 1.3 miles north of Dixon and South Fork of Putah Creek, about 4.2 miles in length, to be graded and paved with portland cement concrete. District X, Routes 7 and 6, Sections E1, A. Heafey-Moore Co. & Fredrickson & Watson Construction Co., Oakland, $369,593; A. Teichert & Son, Inc., Sacramento, $370,227; Fredericksen & Westbrook, Sacramento, $392,457; Claude C. Wood and M. J. B. Construction Co., Stockton, $416,943. Contract awarded to N. M. Ball Sons, Berkeley, $359,902.

Highway Tree Maintenance Work

Sample of tree trimming which increases vision on highway curve

(Continued from page 4)

through theft or mistreatment. The average annual loss of trees and shrubs that have died, been destroyed, or stolen, for the last eight years is in excess of 1,500 plants. In several districts a goodly portion of the tree crew's time is spent in removal and replanting work.

Another bad condition exists at locations where there is easy access from the traveled way to the landscaped areas. At many of these locations the bill for the cleanup of refuse is as large as that for the actual maintenance of the plantings. Particularly is this true at roadside developments such as parking areas and drinking fountains.

During the year 1939-40 two of the districts placed the responsibility for supervision and performance of their fire hazard and noxious weed control work under district tree foremen. Excellent results were obtained. The yearly program for fire hazard and noxious weed control aggregates $160,000 in costs, with the work extending to some portion of each highway district.

Conflict in the correct times of performance of this and regular highway maintenance work necessitates having the growth control work done by a separate crew. Under a planned program of control or eradication, the time element is of utmost importance for effective results in noxious weed work. In many instances, control must be obtained during as short a period as ten days to warrant the expenditure. It is important that control crews are aware of and prepared for that critical time. In a lesser extent this necessity of proper time of performance is also true with the fire hazard control work.

Evans spraybar used in eliminating roadside vegetation alongside State highways

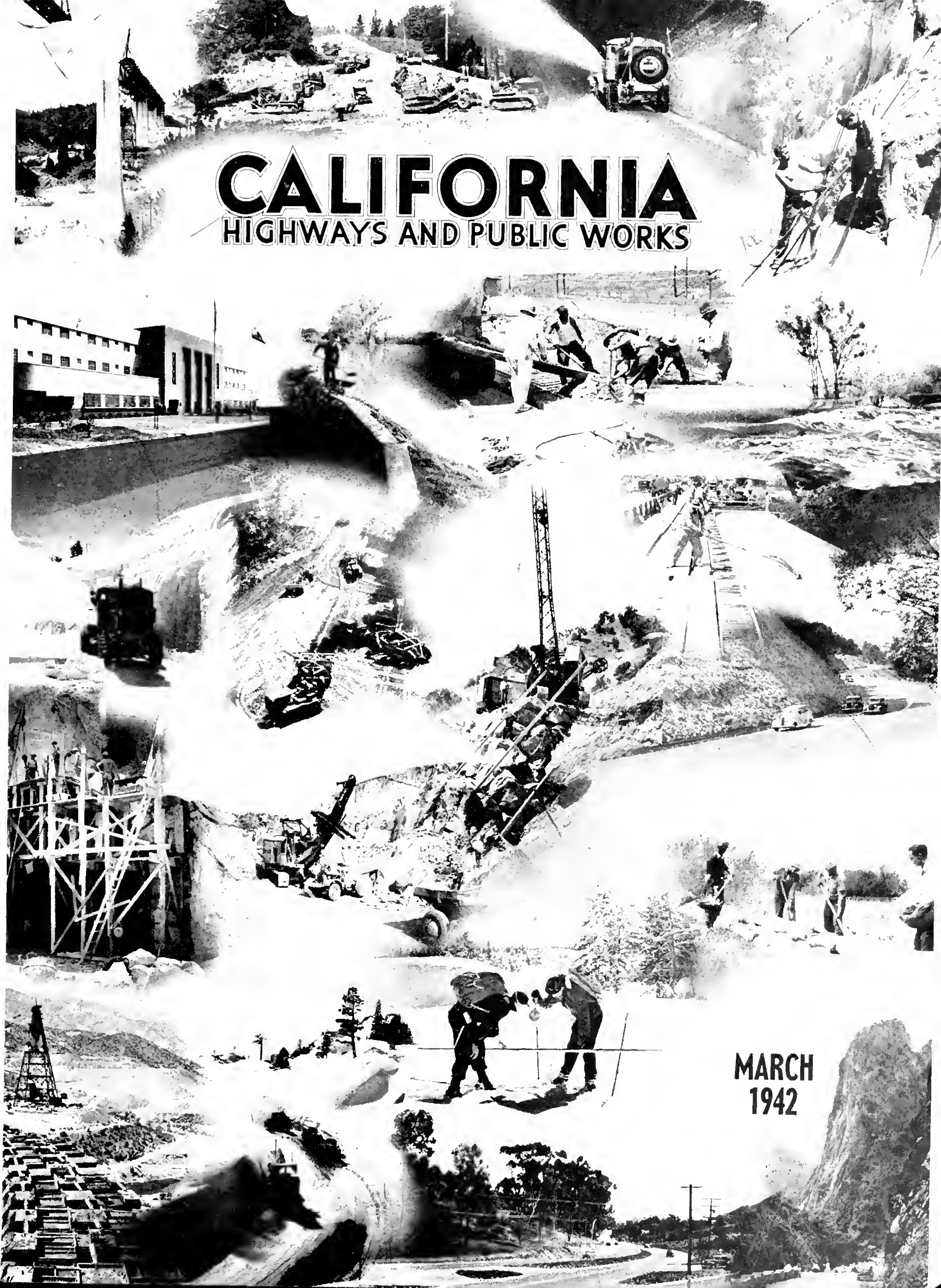
By a more definite programming, particularly of the noxious weed control work, it will be possible to increase in number the tree foremen who can be given this added responsibility.

Seattle Public Library,

Seattle,

Wash.

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



MARCH
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CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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FRANK W. CLARK, Director   C. H. PURCELL, State Highway Engineer   J. W. HOWE, Editor   K. C. ADAMS, Associate Editor

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How Priorities Control System Affects Construction Activities of State Division of Highways

By J. G. MEYER, Assistant Office Engineer in Charge of Priorities

THE all out defense effort has dipped so deeply into the country's productive capacity there are not enough supplies to go around. Hence, in order to insure proper distribution of the available material, some system of control is necessary. "Priorities" is the control system selected by the Federal Government.

Some idea of the seriousness of the present scarcity may be gathered in connection with the Division of Highways' yearly steel requirements for all types of construction. This figure normally approximates 16,000 tons of all kinds of steel—a quantity insignificant in comparison with the Nation's yearly steel capacity of 85,000,000 tons—yet we are certain we shall not obtain even this 16,000 tons for California highways and bridges in 1942.

PRIORITY FUNDAMENTALS

Many people seem to think the "how" and "why" of priorities is a deep mystery. The complexity of the Nation's economic structure does require many forms and procedures. However the essentials for obtaining priority ratings and the application thereof in connection with roadwork is relatively simple.

A priority order gives one the right to obtain delivery of goods in the order of precedence such goods' usage bears to the Nation's war and essential civilian needs. Priority preference ratings range from AA, the highest rating in order of urgency, to A-1, A-2, etc., to A-10; then BB, B-1, B-2, etc.

The A-1 group is further subdivided into A-1-a, A-1-b, to A-1-j. In other words, if you have an A-1-e rating you should theoretically obtain earlier delivery than someone with an A-1-j or an A-2.

The priorities system is founded on the Congressional Act of June 28, 1940 as amended. Basically, it requires manufacturers and suppliers to accept priority rated orders. In other words, purchase orders accompanied by a certain priority rating must be fulfilled before delivery is made on lesser priority ratings or on nonpriority orders.

PRIORITY DEVELOPMENTS

Another basic requirement provides that the holder of a priority certificate must not use it to obtain delivery earlier than needed or in quantities greater than required to complete his project on schedule. Also a priority rating must not be used if delivery can be obtained without priority assistance.

Considerable change has been made in Federal personnel and procedure since priorities were established in June, 1941. At present this tremendous task is administered by the Division of Industry Operations, of the War Production Board (WPB), headed by Donald Nelson. Today the materials of construction are affected also by Federal price controls and rationing as well as by priorities.

The Office of Price Administration (OPA), headed by Leon Henderson, controls prices and rationing. Broadly speaking, the WPB, or Mr. Nelson, administers the war economy while Mr. Henderson, as dual head of the independent OPA and WPB's Civilian Supply Division, controls the civilian economy.

The need for specialized priority knowledge was immediately recognized by the California Division of Highways. Early in June, 1941, engineers were assigned under the direction of R. H. Wilson, Office Engineer, for this purpose. The division at the same time began to plan the adjustments required in normal policy in preparation for a defense economy.

Much credit must be given to the United States Public Roads Administration for its efforts in establishing, for all states, workable procedures for obtaining priority ratings for roadwork and the assignment of the ratings for this work.

This division's first efforts were made by telegram directly to the late Office of Production Management (OPM). Later, telegraphic requests were made through the Public Roads Administration which was able to assist materially because of its knowledge of the road problem and through its direct contact in Washington.

The next development was an OPM letter of August 30, 1941, indicating the priorities applicable to certain types of highway construction in accordance with Federal route classifications. The majority of priority rating orders received by the Division of Highways were obtained under the August 30, 1941, procedure.

DEFENSE CERTIFICATION REQUIRED

The present system for highway priorities requires certification that the project is essential to National Defense in order to obtain certain specified ratings. Such certification is also a requirement today for Federal financial participation in a project. Upon proper request, the local office of the Public Roads Administration initiates defense certification through contact with the Western Defense Command or the United States Engineers Office. Eventually the Secretary of War or Navy certifies the project.

After defense certification justifying expenditure of Federal funds, priority application is made. Where wholly State financed projects are involved, request for certification is made of the PRA in connection with the priority application. The workings of this procedure are indicated by chart on the following page.

When the project is certified and after application, a priority rating is assigned in accordance with the provisions of WPB Administrative Memorandum No. 12 effective December 19th. Such certified projects are termed "classified" projects, and the following ratings will be assigned by the WPB:

RATING CLASSIFICATIONS

(1) For access road projects *Certified* as essential to Defense:

Access roads to military, naval or defense manufacturing plants.	Priority corresponding to rating of establishment served except that highest rating will be A 1 e.

(2) *Certified* projects for correction of critical deficiencies of the Strategic Network of Highways and such other projects as are certified as essential to defense.

(a) All bridge tunnels, structures and approaches other than highway or railroad grade separations	A-2
(b) All other major construction including grading, surfacing and highway and railroad separation structures	A-4
(c) Minor construction projects including shoulder widening and minor drainage structures	A-10

All projects that are not certified are termed "unclassified" and the rating is determined by the WPB, based on the merits of the case in relation to National Defense and Civilian Welfare. Considering our experience to date on this latter type of project, it is assumed any rating granted would be A-7 to A-10 and then only where some connection with defense or civilian health and safety is clearly demonstrated.

LIMITS HIGHWAY PROJECTS

Thus it may be seen that priority ratings will only be granted to those road projects clearly necessary to National Defense, or essential to the public's health and safety for obtaining such critical materials that can not be eliminated by substitution.

This statement may be also used as a summary of policy governing highway, road or street construction where priority assistance is needed. The net effect is a limitation of major construction to the access roads and strategic network.

The following outline indicates in a general way the information required for priority application. The same data is also used to obtain the defense certification referred to above.

A. PRESENT NECESSITY OF PROPOSED WORK

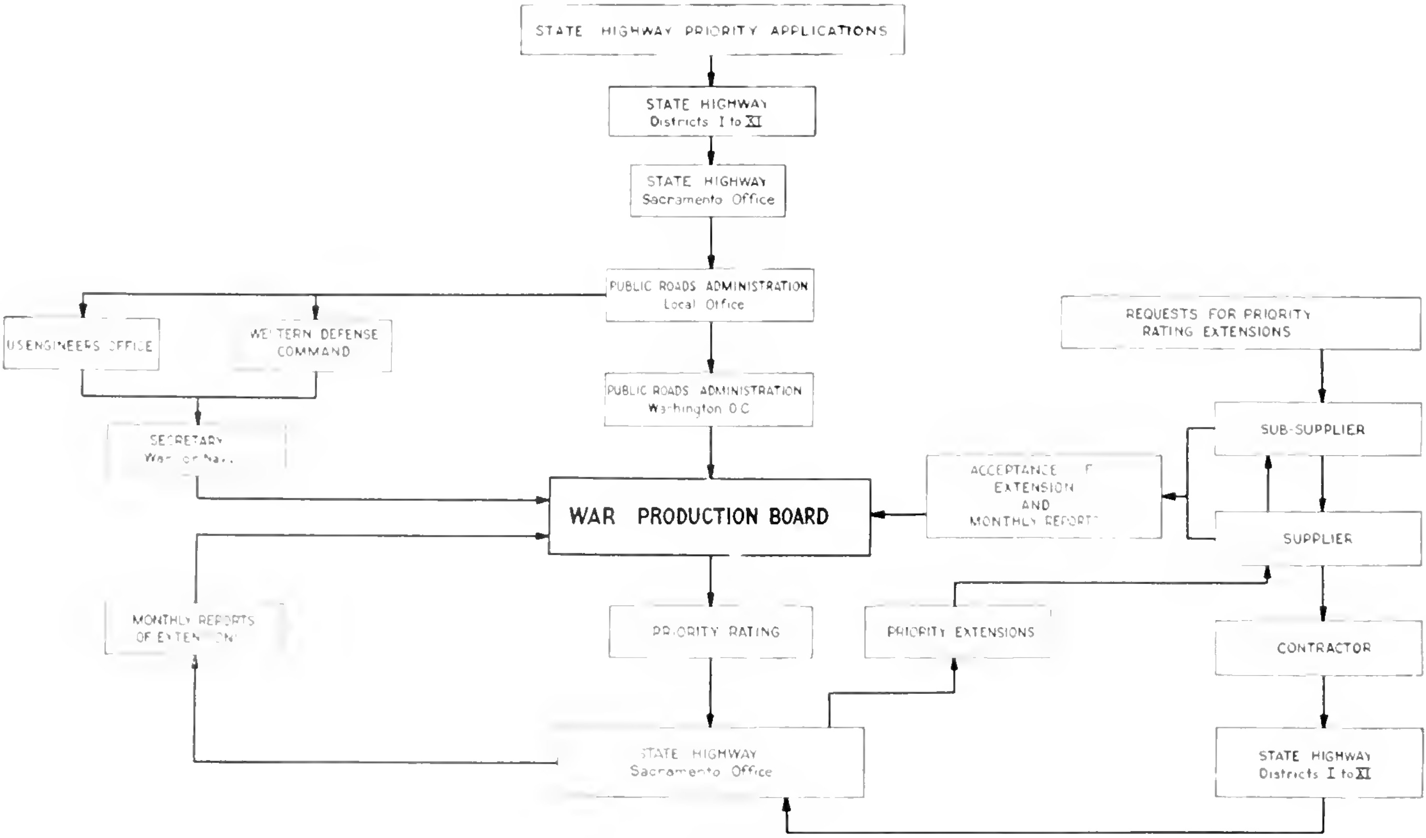
(1) Description of Work
Proposed type of work, costs and complete description of project.

(2) DESCRIPTION OF EXISTING HIGHWAY OR STRUCTURE
Complete factual data on physical characteristics to indicate the specific hazard or deficiency to be eliminated.

(3) TRAFFIC SERVICE
A clear and complete presentation of traffic conditions for which existing facilities are inadequate. To include statistics on traffic accidents, etc.

B. NECESSITY FOR CRITICAL MATERIALS
To include an itemized list segregated into various classes with amounts of steel, non ferrous metals, and other materials which will require priority assistance. This statement must include a detailed statement of reasons why such materials are required and why substitutes can not be used.

Unless such data are completely and specifically presented, applications



are likely to receive little consideration. The application containing the above data is presented in letter form to the PRA for final submission to the WPB.

An important factor in obtaining priority consideration is that of proper design which eliminates critical materials such as steel, copper, rubber, etc. The unjustified use of critical materials will only result in unfavorable consideration of a priority application.

Present regulations prohibit the extension of priority ratings to obtain metal culvert pipe, burlap for concrete curing, metal guard rail or guard rail cable, metal signs or rubber joint material. In effect, the use of such materials is prohibited unless such materials can be obtained without priority ratings. It is expected this restriction will be extended to other nonessential critical materials.

The Division of Highways had anticipated this development and revised its designs accordingly. For example, mass concrete arch culverts without steel reinforcement were developed to supersede, to a large extent, reinforced concrete box culverts. The article by F. W. Panhorst, State Bridge Engineer, in the last issue of this magazine more fully discusses the highway design revisions required to fit the National Defense picture.

The suspension of automobile manufacturing and particularly the rubber scarcity has created a problem in providing and operating the cars needed for conducting highway business. At the present time there is no provision in the rationing program for tires for Division of Highway passenger cars. Likewise, under the rationing plan it will be difficult, if not impossible, to obtain tires for highway construction equipment.

The priorities issued for highway maintenance and construction equipment are largely A-3 to A-10 ratings. Such ratings are usually not sufficient to obtain delivery of construction equipment at any time. We are advised that entire factory productions of certain motor graders are turned over to Army and Navy needs. The obvious conclusion is that we will be forced to make even better use of our available equipment.

While there are many different types of priority orders for various usages, the priority preference ratings generally provided for highway and road work are of three kinds. First, there is the blanket project rating covering the material needs of an entire project that might consist of several contracts.

These priority orders are called P-19-e or P-19-a orders. P-19-e orders are issued for contract construction whereas the P-19-a orders are for strictly day labor projects. There is also the PD-1 or PD-1A certificate covering a specific order of material from a certain supplier. Another is the Maintenance and Repair Order P-100 providing an A-10 rating for maintenance and repair of publicly owned property and equipment.

The PD-1 and PD-1A forms are printed application forms which, when approved, are stamped directly thereon with the priority rating assigned. Our instructions are to use such a form of application for specific signal installations, grade crossing protection work, for publicly owned road equipment, and on construction projects involving only one or two critical materials. The PD-1 form is being superseded by the PD-1A form just issued.

The use of the PD-1A priority form simply involves transmission of the certificate received to the manufacturer of the article purchased.

Extension of the P-19-a or P-19-e certificates requires the contractor to supply copies of his purchase order to the State with the contractor's certification that such purchase order complies with the usual basic priority restrictions. After checking and certification of the contractor's certified purchase orders priority extension is made to the supplier involved. The supplier accepts such priority extension on the forms supplied and may in turn extend the rating to his subsuppliers. Chart No. 2 indicates the various steps in extending priority orders.

The Maintenance and Repair Order P-100 is particularly simple in application. When the purchase requiring priority assistance complies with the restrictions of the P-100 order the following rating statement is placed on the order and signed by the responsible official:

"Material for Maintenance, Repair or Operating Suppliers, under Preference Rating Order P-100 with the terms of which I am familiar."

With certain restrictions, the P-100 order in general provides for maintenance, upkeep and operation of a producer's property and equipment. As applied to roads and highway the "property" to be repaired and maintained comprises the highways, bridges and rights of way under highway administration and the equipment and building, owned by the department.

The P-100 may be used also by a contractor to repair and maintain equipment owned or leased by him. This order may not be used to obtain delivery of new equipment for replacement or as additions. Neither may the P-100 be used to obtain critical materials where substitutes are available such as metal culvert pipe, metal road signs, metal rope or cable for guard rail, metal plate guard rail, or reinforcing steel and under no circumstances to obtain rubber or burlap for highway use.

It may be seen then the trend in priorities is toward tightening of the loopholes in the system to prevent the unjustified use of needed war materials.

While priorities may be a continuous source of irritation to the constructor or designer, we must realize it or a similar system is necessary in order to provide for distribution to the greatest needs. As the war situation changes we may expect corresponding changes in priority regulations.

Bay Bridge will be Insured for $33,750,000

Reinsurance of the San Francisco-Oakland Bay Bridge, which was hampered by the European war, has been assured by a group of San Francisco and eastern brokers according to an announcement by Director of Public Works Frank W. Clark, who is Secretary of the California Toll Bridge Authority.

The bridge will be insured for $33,750,000 as soon as negotiations on the terminology of the insurance policy are completed. The coverage for damage will be the same as has been in effect under the original policies and will be in accordance with bond indenture requirements, Director Clark said.

A considerable portion of expiring insurance on the span was covered by London and European brokers.

Portion of railroad bridge span damaged by February break of Feather River levee in Reclamation District 803

Feather River Flood Did $2,086,000 Damage

FLOOD waters in the Sacramento Valley early in February caused peak flows in the Sacramento River which exceeded at some points the all-time high peak of record set during the February-March storm of 1940.

When the extent of the storm made it apparent that extremely high stages would be reached on the rivers in the valley, State Director of Public Works Frank W. Clark ordered that all possible measures be taken to protect the flood control works under State operation. In addition telegrams were sent to 31 reclamation districts in the flood path informing them of the dangerous stages of the rivers and requesting the districts to maintain patrols on all levees. Emergency patrol crews were placed in all portions of the Sacramento River Flood Control Project under the jurisdiction of the State and additional crews were ordered into the field to combat wave wash and strengthen those portions of the levees which appeared to be weakening.

In spite of the extremely high peaks reached along the Sacramento River, the Flood Control Project successfully carried these flows at all points where levees had been brought up to grade and standard. One serious break occurred near the junction of the Feather River flood channel and the Sutter By-pass in the north levee of the Feather River protecting Reclamation District 803 which had not been rebuilt to standards recommended by the United States Army Engineer Corps for that portion of the project.

DANGER FORESEEN

State Engineer Edward Hyatt, in a letter to Reclamation District 803 on January 9, 1942, pointed out that the levee was in a dangerous condition and advised the district that repairs should be made immediately.

A small amount of repair work was ordered by the district and a patrol maintained as the Feather River approached flood stage, but on the morning of February 8th a break occurred in the levee near the point where the Southern Pacific Railroad line from Knights Landing to Yuba City crossed the levee.

The break quickly widened to a breach 150 feet wide through which a large volume of water was pouring into Reclamation District 803. Emergency crews under the direction of the State Engineer were immediately put to work reinforcing the back levee of the district, not with any hope of stopping the flood waters, but to give farmers in adjoining Reclamation District 823 and Levee District No. 1, an opportunity to move out live stock and farm equipment before their places were inundated. The flood was held here for five hours.

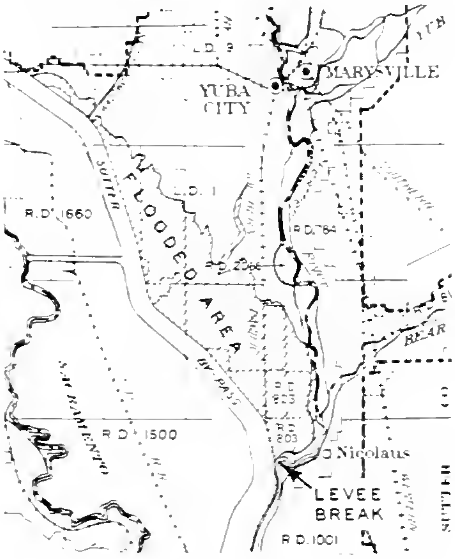
When the flood waters topped the low back levee of District 803, the emergency crews withdrew to the back levee of Reclamation District 823. Here again the waters were checked for an additional seven hours.

By reason of this delaying action on the part of the emergency crews, virtually all of the 6,000 head of live stock in the area were saved, and in addition to moving farm equipment out ahead of the flood waters, many farmers moved their household furniture as well.

Approximately 1,500 persons were evacuated from the area without loss of life.

Before the flood waters abated some 32,000 acres of highly developed and comparatively densely settled farm lands in Sutter County were inundated. At the request of the State Engineer Sutter County officials made a preliminary survey of the flooded area and estimated the possible property and crop damage at $2,086,000.

County estimates were: Farm improvements, $300,000; farm equipment (largely dehydrators, and other heavy equipment that could not be moved), $50,000; railroads, $104,000; highways, $32,000; possible peach



Sketch map of flooded area

crop damage, $1,260,000; other tree crops, $240,000; miscellaneous crops and forage, $100,000.

In addition various portions of the Sacramento River Flood Control Project works sustained damages estimated at $250,000.

As soon as the extent of the flood was determined the State Engineer conferred with Colonel W. T. Hannum, Colonel R. C. Hunter and Henry Rich of the U. S. Engineer Corps to lay plans for closing the breach and draining the inundated area. Ten days after the break occurred equipment was being moved in to begin closing the break. J. R. Morton, of the Marysville office of the U. S. Army Engineer Corps, is in charge of the work.

Less than a week later two-thirds of the break, which had widened to 350 feet, was temporarily closed. The remainder was left open for draining the area, but will be closed immediately if a second storm should cause a rise in the Feather River or Sutter By-pass.

Both No. 1 and No. 2 pumping plants, which are operated by the State for drainage in the area, were in the path of the flood and put out of commission. By March 1st, however, the water had drained from the area to a point where Pumping Plant No. 2 could be operated again.

(Continued on page 16)

Break in Feather River levee of Reclamation District 803, Sutter County, that flooded 32,000 acres of farm lands

Designing Foundation Courses For Highway Pavements and Surfaces

By FRED J. GRUMM, Engineer of Surveys and Plans

The following article is a summary of the principal features of an article bearing the same title which appeared in the November, 1941, issue of this magazine, with additional information intended to supply the answer to many requests for more detail.

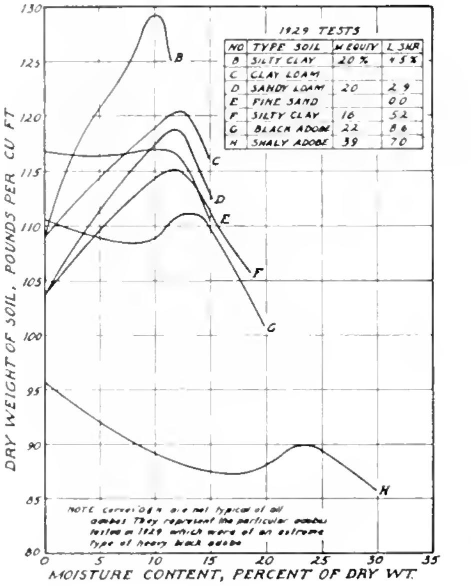
INTENSIVE investigations have been undertaken by many universities, State highway departments, and other engineering agencies to determine the properties of various soils and soil and gravel combinations as support for pavements of various types in order to provide a rational basis for economical highway design.

Choice of a pavement must rest largely on two important factors: the number and magnitude of loads to which it will be subjected and the quality of materials economically available for its support. If foundation materials are poor, and moderate to heavy loads are indicated, the pavement itself may be of a type having considerable structural or "beam" strength, thus reducing the unit stresses transmitted to the subgrade within the limits prescribed for that material. On the other hand, if the surface required is for light to moderate loads and materials with high supporting qualities are available for the foundation, it will probably be found that the most economical design consists of a flexible type surfacing. This latter type has no beam strength and little, if any, greater load spreading characteristics that an equal thickness of well graded crushed rock or gravel and should, therefore, be supported by a "ballast" or base course of sufficient thickness and high enough bearing value to withstand the unit stresses to which it will be subjected.

SOIL INVESTIGATIONS

The Materials and Research Department of the California Division of Highways, under the direction of T. E. Stanton, Materials and Research Engineer, has for many years studied the problem of determining the qualities of soils for use as foundations in highway construction. Tests are made for field moisture equivalent, lineal shrinkage, cementing value, bearing value, swell (expansion), and relative compaction. In some instances chemical tests are also made to detect the presence of injurious salts such as alkalies. Discussions of these investigations may be found in an article "Highway Soil Studies" by Mr. Stanton, which appeared in the June, 1938, issue of this magazine, and a paper by O. J. Porter, Senior Engineer in the Materials and Research Department, who is largely responsible for the development of our bearing value tests, titled "The Preparation of Subgrades," which appeared in the Proceedings of the Eighteenth Annual Meeting of the Highway Research Board, Part II, December, 1938.

FIG 2
CURVES SHOWING TEST RESULTS USING CALIF DIV OF HWY METHOD FOR DETERMINING OPTIMUM MOISTURE FOR SOIL COMPACTION



Experience and observation have shown that the bearing value and expansion tests are of primary significance in determining the qualities of a soil proposed for use in a pavement foundation. These tests are related, and, while modified from time to time, are performed in general as follows:

The sample received from the field is scalped to retain only the material passing a sieve with $\frac{3}{4}$-inch square openings. A test sample consisting of about 5,000 grams of well graded material or about 4,000 grams of fine material, such as sand, is prepared by separating into three sizes: 1. Material passing a No. 4 sieve; 2. Material passing a $\frac{3}{8}$-inch sieve and retained on a No. 4 sieve; and 3. Material passing a $\frac{3}{4}$-inch sieve and retained on a $\frac{3}{8}$-inch sieve. Whenever possible the material is tested with the grading exactly as received from the field. When oversize particles prevent testing by this method, the representative grading is maintained by compensating for the amount of material retained on the $\frac{3}{4}$-inch sieve by increasing the amounts of the two sizes retained on a No. 4 sieve in about equal proportions, keeping the amount of material passing a No. 4 sieve constant. This method in practically all cases represents the poorest condition to be encountered in the field, as the presence of larger particles would increase the bearing value.

MAXIMUM COMPACTION

The prepared test sample is mixed with sufficient water to obtain maximum compaction. This involves several trials with varying moisture content to establish a curve, as shown in Figure 2. When many tests are being made, an experienced operator can determine the proper amount of moisture for satisfactory results without taking the time for numerous trials.

The test sample is then placed in a cylindrical bronze mold, 8 inches in height and 6 inches in diameter, equipped with a base plate of the same material which can be fastened on either end of the mold by friction lugs, and consolidated by applying a load of 2,000 pounds per square inch with a hydraulic jack illustrated by type "A" in Figure 1.

After consolidation, the height of the compacted material is measured, and then a piston with a cross-sectional area of three square inches, in the hydraulic jack illustrated by type "B" in Figure 1, is set on top of the compacted specimen, the Ames dial is set at 0.0 inches, and a load applied to produce a penetration of 0.05 inches per minute. The loads required to cause succeeding penetrations of 0.1 inch, 0.2 inch, 0.3 inch, 0.4 inch and 0.5 inch are recorded. When this is finished, the top inch or two of the material is disturbed, and the base plate is placed on the opposite end of the mold with filter paper placed between base plate and mold. The material is then recompacted with a load of 2,000 pounds per square inch, and the height measured. A filter paper is then placed on top of the specimen and a perforated bronze plate about ¼-inch in thickness and about 5¾-inches in diameter is placed over this. The distance from the top of the mold to the perforated plate is measured with a depth gauge graduated to 0.01-inch intervals. The specimen is then placed in a tank of water to soak, with a bronze weight of 10 pounds placed on top of the perforated plate. The height of the material is measured every day up to a maximum of four days, and when the swell ceases the sample is again placed in the hydraulic jack and tested for bearing value.

The hydraulic jacks described above are for use in making tests in the various districts. Final results, especially on critical materials, such as selected base and imported borrow materials, are based on tests made with a specially designed bearing value machine, making the same type of test with greater refinement, in the Headquarters Laboratory in Sacramento. Tests in District VII are made in a similar machine in Los Angeles.

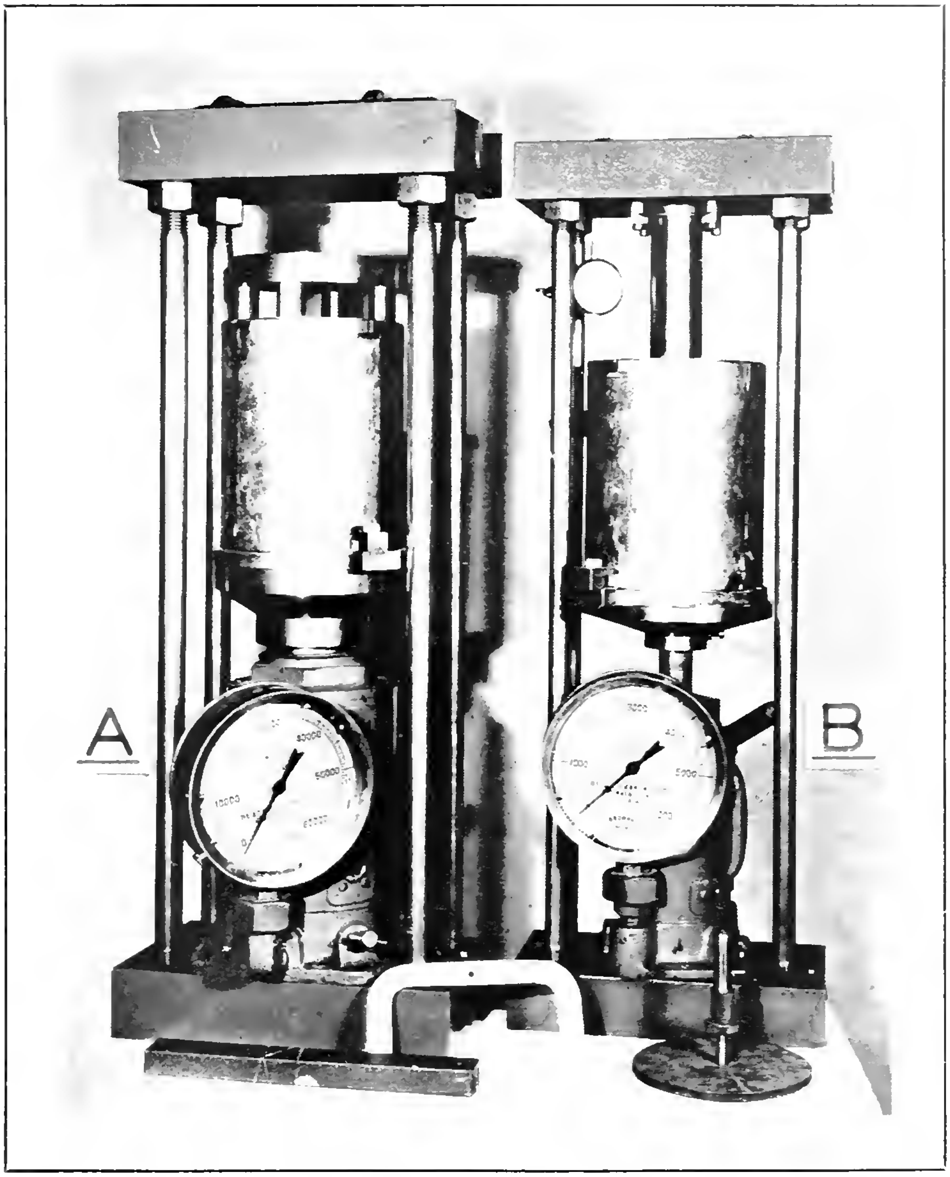


Figure 1—Hydraulic jacks compression testing assemblies. A—For consolidating soil sample. B—For bearing test

BEARING VALUES

The bearing values are listed in percent of a standard load which has been determined from our experience. The standard loads are as follows:

Loads in pounds per square inch

Penetration	Soaked	Unsoaked
0.1 inch	2,000	1,000
0.2 inch	2,800	1,500
0.3 inch	3,400	1,900
0.4 inch	3,800	2,300
0.5 inch	4,300	2,600

We have found that the bearing value at 0.1-inch penetration, compacted and soaked, is probably the most reliable indication of the quality of the soil. This must not be taken to mean, however, that careful study should not be made of all the characteristics of the soil sample, including the bearing values at all penetrations, both soaked and unsoaked, in order to make a proper evaluation of the qualities of the material. On the basis of bearing values at 0.1-inch penetration, compacted and soaked, we have prepared a chart of desirable total thickness of base and surfacing over soils of various bearing values, shown in Figure 3.

FACTORS IN DESIGN

At the present time we are striving to attain the following standards in subgrade construction:

Portland cement concrete pavement: subgrade consisting of a minimum depth of one foot of material with a minimum bearing value of 20 per cent at 0.1-inch penetration, compacted and soaked, and swell less than 3 per cent.

Cement treated base: subgrade consisting of a minimum depth of one foot of material with a minimum bearing value of 20 per cent at all penetrations, compacted and soaked, and swell less than 3 per cent.

Asphalt concrete: subgrade consisting of a minimum depth of one foot of material with a minimum bearing value of 30 per cent (preferably 50 per cent) at 0.1-inch penetration, compacted and soaked, and swell less than 3 per cent.

Bituminous surfacings: subgrade to be from 6 inches to 24 inches in depth, dependent on underlying soils, climate and traffic, the top 6 inches to be composed of material with a minimum bearing value of 80 per cent at 0.1-inch penetration, compacted and soaked, with swell less than 3 per cent. Approximate depths of succeeding blankets of lower quality materials may be secured from the chart.

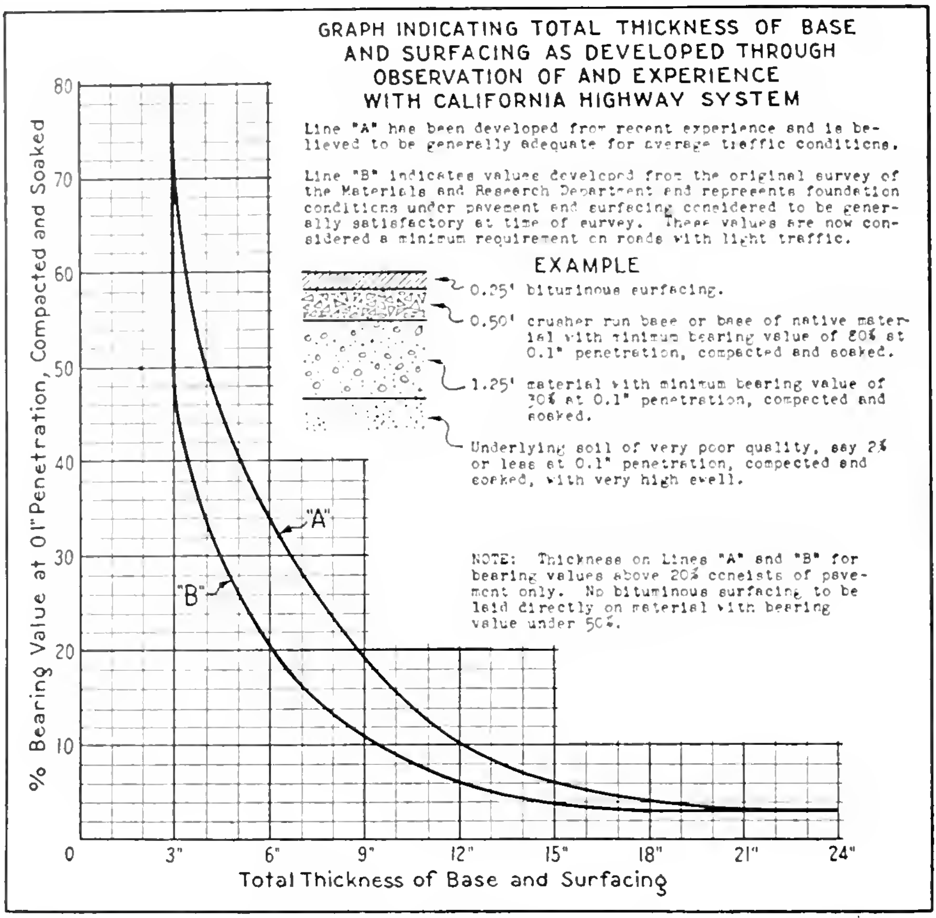


Figure 3—Showing relation between subgrade bearing value and total thickness of base and surfacing

LOAD DATA

The other very important factor in design is the determination of the number and magnitude of loads to which the pavement will be subjected. To use this information intelligently, we must equate the loads to a chosen standard. For example, we have all seen roads which have given many years of service under large volumes of light traffic fail almost instantaneously when, for some reason, continuous heavy truck traffic is routed over them.

Our adoption of a standard wheel load and "weighted" figures to apply to other loads in order to secure the total number of equivalent repetitions of the standard load is based on studies of the behavior of portland cement concrete pavement under load stress; studies of the work of Dean H. M. Westergaard, who is responsible for developing the first rationalized analytical theory of stress calculation for portland cement concrete pavement, and a later book, "Reinforced Concrete Pavements," by Royall D. Bradbury, of the Wire Reinforcement Institute, published in 1938. A table on page 60 of the latter book, based largely on investigations of the Illinois Division of Highways, is referred to later in our methods of determining equivalent load repetitions.

The basis of all practical data, is, of course, the actual counting and weighing of vehicles on the highway. These data have been accumulated by our Highway Planning Survey conducted in cooperation with the Public Roads Administration.

With these traffic data in hand, various highway surfacings have been observed and studied in the field and their behavior and condition correlated with the data. Credit for much of the study and information secured therefrom is due to A. M. Nash, until recently Assistant Engineer of Surveys and Plans, and now Assistant District Engineer of District IV in San Francisco.

Probably the best explanation of the method of computation used is an example, which is shown in Figure 4.

Table 1 shows the method of compiling and computing traffic data and equivalent wheel load repetitions.

Table 2 is copied from a page of the traffic data tabulation prepared by our Highway Planning Survey, and shows *average daily traffic* both from the standpoint of *total traffic* as well as *truck* or *commercial traffic*. These data are developed each year from our annual State-wide 16-hour (6 a.m. to 10 p.m.) traffic counts taken for two days in each July (a Sunday and a Monday). These annual traffic counts are analyzed and proper equating factors applied to convert them to 24-hour *daily average traffic*, which is the figure shown in the tabulation. The proper factors for each section have been developed from data accumulated at automatic recorder stations, continuous count stations, special count stations, etc. These are constantly being verified and extended.

Table 3 represents a page from the tabulation prepared by the Highway Planning Survey of the results of its State-wide study of the type, character and weight, and relative distribution, of the commercial increment of traffic using the State highways. Some 106 stations were established at strategic locations throughout the State, at each of which a representative cross-section of commercial traffic was sampled to form the basis of the data shown in Table 4. The data

(Continued on page 20)

FIGURE 4

ROAD VI-KER-4-E

Loadometer Station L-52

Limits: South of Famoso____

Average daily traffic (1940)_______________	6629	Average=2163
Average daily commercial traffic 1940________	1442	
Est. average daily commercial traffic 1950____	2884	

2163 x 365 x 10 x 2.88=22,737,456 axle loads in 10 years

Wheel Load Groups

1. 4500-5500 _____	10.71%=2,435,182	x 1=	2,435,182	Estimated equivalent 5000 pound wheel loads in 10 years
2. 5500-6500 _____	9.61%=2,185,070	x 2=	4,370,140	
3. 6500-7500 _____	11.96%=2,719,400	x 4=	10,877,600	
4. 7500-8500 _____	6.02%=1,368,795	x 8=	10,950,360	
5. 8500-9500 _____	3.40%= 773,074	x 16=	12,369,184	
6. 9500 and over_	0.91%= 206,911	x 32=	6,621,152	

Total estimated equivalent 5000# wheel loads in 10 years___ 47,623,618

Design repetitions (traffic in one direction)_______________ 23,811,809

REMARKS: Loadometer station at Junction of Routes 4 and 33 at Famoso.

TABLE 1

RURAL STATE HIGHWAY SYSTEM TOTAL AVERAGE DAILY TRAFFIC AND AVERAGE DAILY TRUCK TRAFFIC 1940

Roads are arranged in order by County, Route and Section

County	*Route*	*Section*	*Total average daily traffic*	*Average daily truck traffic*	*Trucks, percent of average daily traffic*
INY	128	A	73	13	18
KER	4	A	6123	1131	18
		B	6110	1222	20
		C	8553	1913	22
		D	7886	1517	19
		E	6629	1442	22 ←
		F	5975	1418	24
		G	8272	1701	21
KER	23	A	1658	322	19
		B	826	157	19
		C	747	155	21

TABLE 2

GROSS WEIGHT DISTRIBUTION OF COMMERCIAL OUTFITS
Loadometer Station No. 52
Location, Famoso-Junction Routes 4 and 33

Direction and route	*North on 4*		*South on 4*		*West on 33*	
Gross weight of outfit in pounds	*Number*	*Per cent Cumulative*	*Number*	*Per cent Cumulative*	*Number*	*Per cent Cumulative*
Under 10,000____	232	37.5	178	30.1	141	48.3
" 20,000____	365	59.0	324	64.8	204	69.9
" 30,000____	460	74.3	426	72.1	238	81.5
" 40,000____	519	83.4	478	80.9	258	88.4
" 50,000____	556	89.8	529	89.5	267	91.4
" 60,000____	580	93.7	546	92.4	272	93.4
" 68,000____	599	96.8	560	94.8	279	95.5
" 80,000____	616	99.5	582	98.5	291	99.7
" 90,000____	619	100.0	591	100.0	292	100.0
Average gross weight __________	21,350		23,566		17,890	
Average axle weight __________	7,138		8,179		6,133	
Ratio $\frac{\text{Aver. gross wt.}}{\text{Aver. axle wt.}}$ ____________	2.99		2.88 ←		2.92	

TABLE 3

ANALYSIS BASED ON SPRING-SUMMER STRESSES

Induced stress (lb. per sq. in.) (1)	*Equivalent wheel load in pounds* (2)	*Equivalent repetitions divided by actual repetitions* (3)	*Multiplier of previous figure* (4)	*California adopted factors* (5)
396	5,000	$\frac{600}{600} = 1$		1
			2.667	
416	6,000	$\frac{1467}{550} = 2.667$		2
			2.454	
435	7,000	$\frac{3273}{500} = 6.546$		4
			2.391	
454	8,000	$\frac{7044}{450} = 15.653$		8
			2.091	
472	9,000	$\frac{13091}{400} = 32.728$		16
			2.200	
489	10,000	$\frac{25200}{350} = 72.000$		32

TABLE 6

DISTRIBUTION OF AXLE WEIGHTS AT LOADOMETER STATIONS
Station No. 52. Location, Famoso
Direction, S. on Rt. 4. Total Outfits, 490

Axle weight, lbs.	Axle designation							Total	Per cent
	A	B	C	D	E	F	G		
Less than 1,000									
1,000- 1,999	43	16	3	1				63	4.12
2,000- 2,999	78	32	14	9	4	2		139	9.09
3,000- 3,999	138	37	10	10	7	3		205	13.40
4,000- 4,999	70	26	17	9	4	3		129	8.43
5,000- 5,999	51	33	11	9	6	3		113	7.39
6,000- 6,999	29	22	19	8	2	1		81	5.29
7,000- 7,999	23	36	10	5	2	1		77	5.03
8,000- 8,999	24	23	11	10	2	1		71	4.64
9,000- 9,999	19	27	21	9	1	3	1	81	5.29
10,000-10,999	13	25	24	16	4	1		83	5.42
11,000-11,999	2	16	15	18	5	6		62	4.05
12,000-12,999		25	30	19	6	5		85	5.56
13,000-13,999		30	19	24	7	4		84	5.49
14,000-14,999		44	22	17	11	5		99	6.47
15,000-15,999		31	5	13	5	3		57	3.73
16,000-16,999		17	6	8	3	1		35	2.29
17,000-17,999		20	5	2	2			29	1.90
18,000-18,999		18	2	1	2			23	1.50
19,000-19,999		6	1			1		8	.52
20,000 and over		6						6	.39
Totals	490	490	245	188	73	43	1	1,530	100.00
Accum. axle wt. in 100 lbs.	22,059	48,111	23,500	19,481	7,524	4,380	90	125,145	
Avg.axle wt.in 100 lbs.	45	98	96	104	103	102	90	8,179	

TABLE 4

	Induced stress (lb. per sq. in.)	*Per cent of mod. of rup. strength*	*Repetitions required to cause rupture*	*Actual repetitions per year*	*Equivalent repetitions per year based on stress of 396 lb. per sq. in.*
Spring-Summer	396	52.8	360,000	600	600
	416	55.5	135,000	550	$550 \times \frac{360,000}{135,000} =$ 1,467
	435	58.0	55,000	500	$500 \times \frac{360,000}{55,000} =$ 3,273
	454	60.6	23,000	450	$450 \times \frac{360,000}{23,000} =$ 7,044
	472	63.0	11,000	400	$400 \times \frac{360,000}{11,000} =$ 13,091
	489	65.2	5,000	350	$350 \times \frac{360,000}{5,000} =$ 25,200
Fall-Winter	313	41.3	Infinite	600	0
	333	44.4	Infinite	550	0
	352	47.0	Infinite	500	0
	371	49.5	Infinite	450	0
	389	51.9	520,000	400	$400 \times \frac{360,000}{520,000} =$ 277
	406	54.2	220,000	350	$350 \times \frac{360,000}{220,000} =$ 573
					Total= 51,525

Crack expectancy= $\frac{360,000}{51,525}$ =7 years

The above table is copied from page 69 of "REINFORCED CONCRETE PAVEMENTS," by Royall D. Bradbury, published by the WIRE REINFORCEMENT INSTITUTE in 1938.

TABLE 5

Santa Barba[...] Improveme[...]

By L. H. GI[...]

THE completion of two major projects on the Coast Highway marks another milestone in the progressive improvement of this road in Santa Barbara County. The two projects are located along the ocean shore between Tecolote Creek and Las Varas Creek and between Orella and 1 mile west of Canada del Refugio.

This reconstruction consisted of three separate contracts and was started in August, 1940, when a contract was awarded to Basich Brothers of Torrance for grading and surfacing the section between Tecolote Creek and Las Varas Creek, a length of 3.4 miles.

In September, 1940, a contract was awarded to Carl Hallin for the construction of a new reinforced concrete girder bridge across Dos Pueblos Creek within the limits of the road contract. A third contract was awarded in October, 1940, to Basich Brothers for the grading and surfacing between Orella and 1 mile west of Canada del Refugio, a length of 2 miles.

Traffic using this route has varied from an average of 2,000 cars per day in the winter months to 6,000 in the summer, with particularly heavy concentrations on Sundays and holidays as recreationists sought the beach areas. For this volume of traffic the alignment, grade and surface on both of these sections were considerably substandard.

The designs for the new sections were made to eliminate these obsolete features. Comparative tabulation between the old and new sections of highways clearly indicates the improvements effected by the reconstruction.

	Tecolote Creek to Las Varas Creek		Orella to One Mile West Canada del Refugio	
	Old	New	Old	New
Total number of curves	8	4	10	4
Total curvature	146	63°	210	211°
Minimum Radius	358 ft.	5000 ft	700 ft	1000 ft.
Maximum Grade	6.5%	3.1%	6.8%	3.9%
Minimum vertical sight distance	320 ft.	1400 ft.	320 ft.	875 ft.
Minimum horizontal sight distance	240 ft	900 ft.	360 ft.	475 ft.

Before pictures of danger points on highway that called for widening, realignment or replacement

County Completed

District Engineer

In the design of the section between Tecolote Creek and Las Varas Creek the new standards of construction are those for a high type of two-lane thoroughfare. On the Orella portion of the route, however, the road at Canada del Refugio was restricted between the location of the railroad on the ocean side and the rapidly rising hills on the north.

4-LANE MOVE EXPEDIENT

The cost of the necessary heavy grading for construction to similar standards of curvature required for modern two-lane highway was such that it was found more expedient to somewhat reduce the standards of alignment and construct the road as a four-lane divided highway.

Soil conditions throughout both of these sections are poor and a one-foot blanket of imported borrow was placed over the full width of the roadbed to insure a suitable foundation. A base course six inches in thickness was constructed of cement treated aggregate.

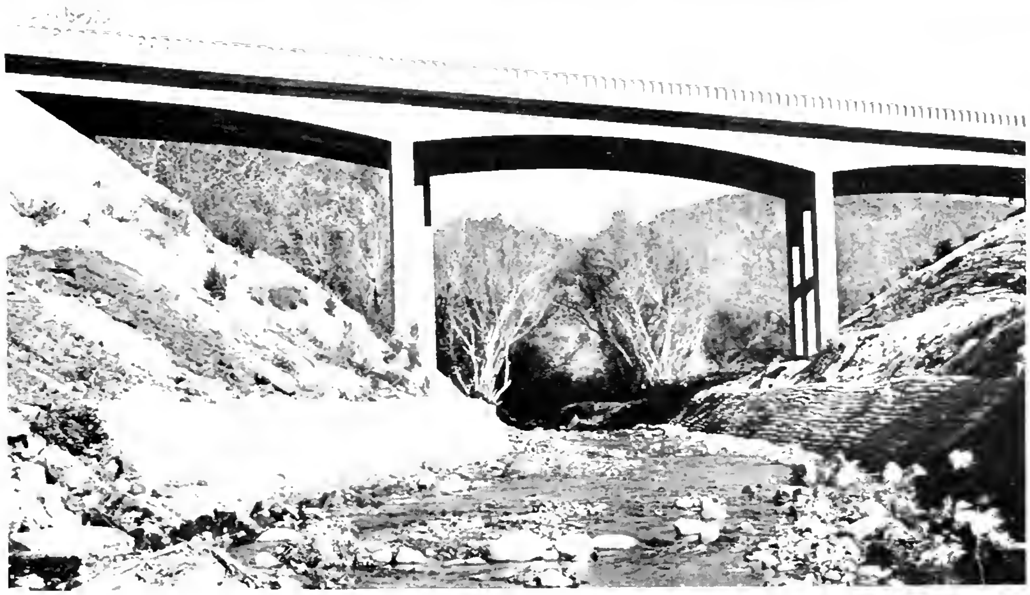
The surface placed on top of this base consists of a plant-mixed surfacing three inches in thickness. On the two-lane sections the roadbed was graded to a width of 36 feet with a cement treated base being 24 feet in width and the surfacing 22 feet in width.

On the four-lane portions the roadbed was graded 64 feet in width and the cement treated base was constructed 50 feet in width, with the surfacing 50 feet in width. The shoulders and gutter or dike were surfaced with plant-mix surfacing on both projects.

DRAINAGE STRUCTURES INSTALLED

The work in the construction of the section between Tecolote Creek and Las Varas Creek involved 381,000 cubic yards of roadway excavation, 35,000 cubic yards of imported borrow, 13,000 tons of cement treated

(Continued on page 16)



After pictures of improvements that remedied bad traffic conditions shown on adjoining page

Problems Of Highway Maintenance Arising Out Of The War Emergency

By W. A. SMITH, Assistant Maintenance Engineer

PROBLEMS faced by the Division of Highways organization in maintenance of the State highways during the war were discussed by the Maintenance Engineers from all districts in the State at Sacramento on February 24th and 25th.

Mr. Franz R. Sachse, Assistant Director of Public Works, Mr. G. T. McCoy, Assistant State Highway Engineer and Mr. Robert E. Reed, Attorney of the Division of Contracts and Rights of Way, presented the general view of these problems. In addition to maintenance work, matters relating to personnel, accounting, equipment and safety and traffic were taken up and discussed at length with the heads of the respective departments. The meeting was conducted by Mr. T. H. Dennis, Maintenance Engineer.

The effect of the rationing of tires and automobiles on California's income from the gasoline tax was discussed and it was pointed out that the Division of Highways is going to have less money with which to carry on normal work and the Maintenance Department is going to feel the impact from reduced revenues. It is certain as time goes on, the engineers were told, you will find an increased problem in maintaining roads originally built for light normal traffic which now are required to carry heavy military traffic.

The effect of curtailment of traffic on highway revenues will become apparent beginning with the April collections. This is due to the lag of two months between levy and collection. It is impossible to make a firm estimate as to probable decrease in revenue.

Several factors affecting the highway maintenance work were brought out during the conference. The more serious of these matters are as follows:

1. Accelerated damage to highway surfaces due to general increase in hauling is already apparent.

2. A further increase in bus and truck traffic must be anticipated along with the decline in passenger car traffic as the war effort intensifies. This is the portion of the traffic which most seriously damages the road surfaces.

3. Limiting of reconstruction of highway surfaces; first, by reduction in revenue available for the purpose; and, second, effect of Federal regulations limiting priorities for securing materials and equipment to projects which are either on access highways or on the strategic network.

4. Evidence that damage to the surfaces on nonstrategic highways is as great as on the strategic highways. This is especially serious as the military and defense work forces will necessarily use these roads without regard to their condition and without considering the fact that funds for construction will be limited or not available. Estimates of damage to highway surfaces by defense hauling in recent months shows a total of over $1,600,000 is required for adequate restoration. Of this amount some 64 per cent is required on nonstrategic highways.

5. Difficulties in securing materials and in connection with keeping up equipment and the organization are foreseen. Maintenance of highways involves considerable quantities of materials. Securing these materials in the face of military needs for surfacing airports and for other defense projects is increasingly difficult. This same situation applies in regard to equipment. In the past the division has rented privately owned trucks, power shovels, tractors and similar heavy equipment in considerable amounts each year to work on slide removals and surface repair work. This equipment is now working full time on defense projects and there is no assurance it will be available as in the past. The maintenance forces must therefore rely on use of State-owned equipment. Replacement of worn out equipment is uncertain and even the securing of replacement parts will involve delays.

Most of the men in the organization are experienced along engineering, mechanical or operating lines. When not called into the armed forces many of them are tempted to consider employment either with contractors or defense plants. The State service can not compete with private industry in rates of pay or the opportunity for making extra money by overtime work. In some cases there is a feeling, also, that it is more patriotic to engage in such work but proper maintenance of the State highways is essential work both from the public and military viewpoint.

6. Reconstruction of surfaces on State highways has not kept pace with traffic demands or normal deterioration. The demands on State highway funds have been great especially since 1933 when the mileage in the system was practically doubled without extra allowance for financing. Restoration of surfacing has not kept pace with the deterioration resulting from use and weathering nor with obsolescence.

Reports of actual failures at many points and signs of impending failures at other locations were cited as evidence of this situation. Discussion emphasized that a program of restoration and strengthening the surface on at least 300 miles of the system should be undertaken this year in order to adequately serve traffic during and for a period immediately following the emergency. The financing of such a program is outside the scope of maintenance.

7. Possibilities of reduction in highway maintenance work: The conference devoted considerable time to discussion of this subject. Reduction in expenditures may be brought about either by elimination of certain functions or by lowering the standard of work. These measures may be applied either to a portion of the

Group of Maintenance Department executives of the eleven highway districts who attended Sacramento meeting to consider economy measures necessitated by war situation—Front row: H. B. La Forge, H. S. Comly, C. E. Bovey, T. H. Dennis, W. A. Smith, G. F. Hellesoe, J. E. Stanton. Second row: Thos. Eastman, H. L. Cooper, E. E. Evers, C. F. Woodin, R. H. Stalnaker, W. L. Fahey, F. L. Meyer, E. S. Whitaker, E. M. Cameron. Third row: R. B. Millard, N. R. Bangert, R. D. Kinsey, J. M. Hodges, J. C. Womack, C. E. Thompson, P. L. Fite.

highway system or uniformly to the system as a whole. As an offset against any savings which might thus be made, it was pointed out that there are increased expenditures inherent in the war emergency.

For example over $100,000 of the funds allocated for maintenance purposes have been expended since December 7, 1941, to pay wages of guards at important bridges, at stations where valuable equipment is stored and at powder magazines. This expenditure has been necessary to reduce the possibility of damage or destruction through sabotage which might close an important highway.

Delays in delivery of material, lost time in waiting on repair of equipment and changes in the personnel are all matters which can not be avoided and yet cause added expense in a time of emergency.

Work which can best be eliminated would, at first glance, include items of improved service such as reduction in traffic striping, highway lighting, weed eradication, spraying and burning roadside vegetation to reduce fire hazard, care of trees and shrubbery, snow removal, sanding icy pavement and placing nonskid surfacing.

Items of this kind represent some 12 per cent of the total amount budgeted for maintenance purposes. The work is of unquestionable public benefit but only a small part is essential to preservation of the highways.

Major expenditures in the improved service class include traffic striping and snow removal. The program for traffic striping is being reviewed with the thought of reducing the width of stripe, limiting the work to only the most important routes and lowering requirements as to visibility of the stripe. It is estimated annual expenditures for the work might be reduced $100,000 by applying such measures.

The program for snow removal may be reduced by eliminating work on strictly recreational routes and spring work on roads which are closed during the winter.

Consideration will be given to elimination of the program of spraying and burning roadside vegetation in selected areas next season. This latter program, while of no direct benefit to the highways, is important in reduction of fire hazard on adjoining property and has received general support from agricultural and lumbering interests in the past.

It should be kept in mind that programs such as traffic striping and highway lighting were undertaken solely to reduce hazard. Elimination of service at one point or in favor of retention of some other service must answer the test of necessity.

The care of roadsides normally requires over 30 per cent of the funds used for highway maintenance. For the 1940-41 season $3,158,500 was expended. Of this total $2,528,500 or 80 per cent was required for slide removal and storm damage repair. Such

(Continued on page 17)

Grading Completed For Widening Grapevine Grade From 3 to 4 Lane Highway

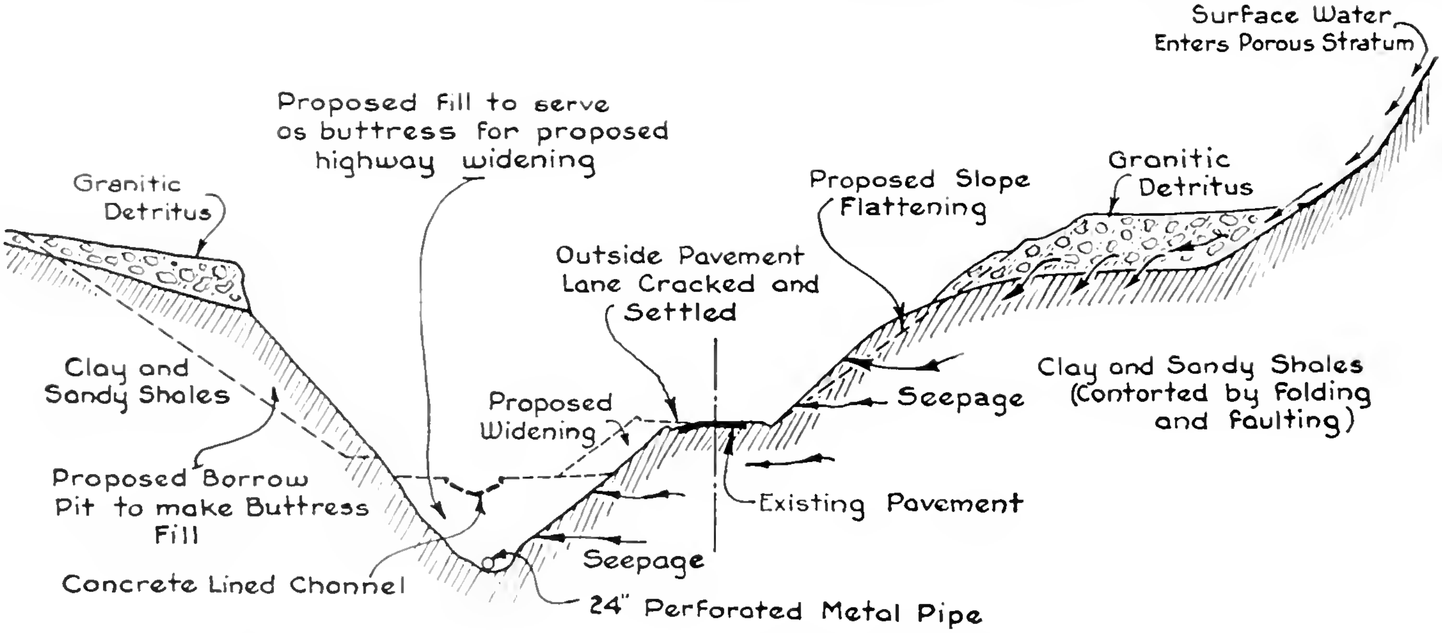
By E. T. SCOTT, District Engineer

THE first step in the elimination of one of the State's most hazardous stretches of highway has been completed. Griffith Company of Los Angeles have finished grading operations for the widening of Grapevine Grade on U. S. 99 from a three-lane to a four-lane divided highway.

Work just completed was along a portion of the Ridge Route in Kern County from Old Fort Tejon northerly and down hill on a continuous vehicles traveling at a high rate of speed overtake the slow moving trucks.

If the truck is observed soon enough and if the center lane of the three-lane pavement is not occupied by vehicles moving in the opposite direction, nothing happens. Unfortunately conditions have not always been right, and the result has been that this 6-mile stretch of continuous 6 per cent grade down the hill has taken an annual toll for the past few has been stabilized. The stabilization consisted of two operations. The interception and draining of water from the hillside above the highway and the buttressing of the highway embankment by filling the canyon below the highway.

At various places along the hillside numerous holes were drilled by hydraugers. Starting at a point two or three feet above the highway gutter grade, the holes were drilled from



Sketch showing plan for proposed buttress fill and highway widening on Grapevine Canyon

6 per cent grade. The widening connects with the southerly end of a 19-mile stretch of four-lane divided highway extending north toward Bakersfield.

This important transportation route which connects Los Angeles with the San Joaquin Valley has a daily traffic average of nearly 6,000 vehicles, of which about 20 per cent are trucks and trailers.

Because of the 6 per cent grade on the Grapevine Grade, trucks travel at a very slow rate of speed, while traveling in either direction. Not being hindered by the grade, passenger years of from 10 to 14 killed and many more injured.

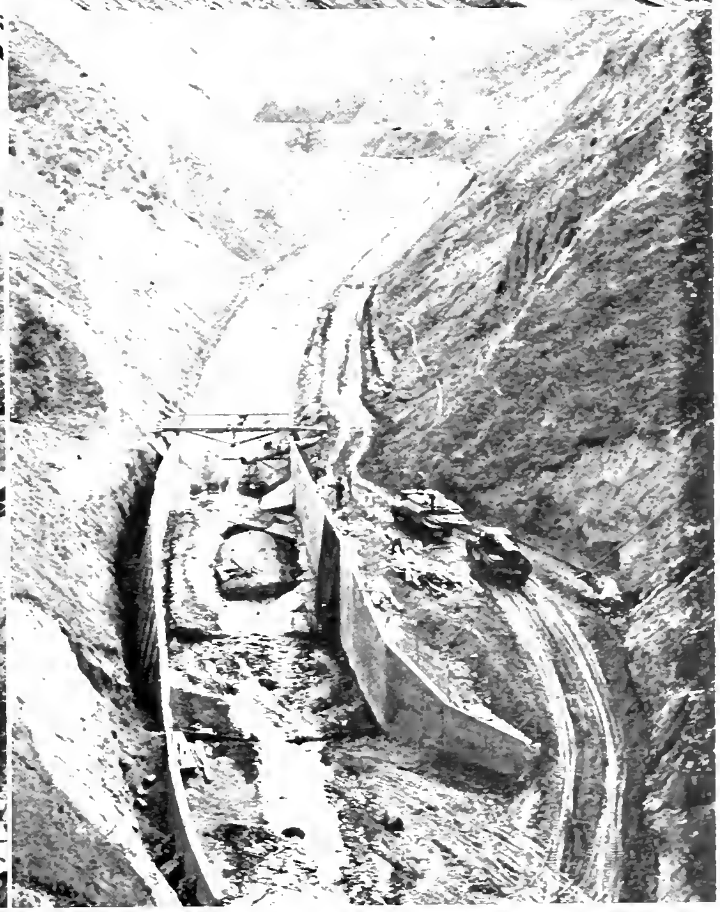
While the work just completed provides a wider roadway, the improvement of traffic conditions will have to await the widening of the pavement under a new contract which will be under way in a few weeks.

SLIDE STABILIZED

One threat to a portion of this highway has been eliminated. A badly saturated hillside from which many slides have come in on the highway and threatened to carry the roadway into the canyon of Grapevine Creek, two or three degrees above horizontal to 20 degrees above horizontal in order that any water encountered would flow freely to the highway gutter.

Holes were drilled for various lengths up to 170 feet. Some of the holes were dry but a great many of them intercepted water and the flow from the holes, which were provided with two-inch perforated pipes, ran from a few drops up to 200 gallons per hour.

The highway embankment was buttressed by filling the canyon below the roadway for a distance of nearly 2,000



Top picture shows completed portion of flume, paralleling Grapevine Grade highway, for carrying creek waters past slide area. Lower pictures show work on reinforced concrete lining of flume and the special spillway construction at its lower end feet and to a depth of about 40 feet. To prevent the possibility of the creek cutting out this buttress fill, a concrete lined channel with special spillway at the lower end was constructed. Some 3,800 cubic yards of reinforced concrete were used and provided a channel capable of handling 3,000 second-feet of water. It has been said by persons dwelling on the hill above the highway, that since the buttress has been completed, ground vibrations previously felt when heavy trucks pass on the highway, have ceased.

HEAVY CURBING CONSTRUCTED

As a part of the contract, 3,000 lineal feet of heavy curb with a 15-inch vertical face was constructed on what will be the outside edge of a 10-foot shoulder on the down hill traffic lane. The curb is located near the top of the grade along a stretch of highway where in the past several trucks have gone out of control and have sought guard rail and other obstacles to rub up against to retard their speed. The curb as constructed more or less as an experiment, it is believed will be very effective in aiding runaway vehicles.

Grading operations, which involved over half a million cubic yards of earth and rock and the importing of about 60,000 cubic yards of borrow material, were carried on with practically no interference with traffic.

Work was carried on under the supervision of Resident Engineer Don Evans with W. E. Bertken acting as Resident Engineer on the job.

New Traffic Problem Study

A new study of traffic problems entitled "Traffic Accidents and Congestion" by Maxwell Halsey, Associate Director, Bureau of Street Traffic Research, Yale University, has recently been published. Setting forth the principles which underlie the scientific methods currently being developed to reduce traffic accidents and congestion, this volume approaches traffic problems from the engineering point of view and is intended not only for traffic students but for those professionally engaged in traffic and highway engineering.

"Believe me, if my wife scolds me for coming home late, I'm going to tell her a thing or two."

"Don't do it! Tell her one thing and stick to it."

Improvements Completed in Santa Barbara County

(Continued from page 11)

base and 15,000 tons of plant-mixed surfacing. In addition to these items, drainage structures consist of a reinforced concrete arch culvert which was constructed at the crossing of Eagle Creek and pipe culverts varying in size from 18 inches to 36 inches in diameter which were placed throughout the project.

The work on the section between Orella and 1 mile west of Canada del Refugio involved 164,000 cubic yards of roadway excavation, 33,000 cubic yards of imported borrow, 14,000 tons of cement treated base and 11,500 tons of plant-mixed surfacing.

In addition to the above items, drainage structures were placed throughout the project. A reinforced concrete girder bridge was constructed across Refugio Creek, consisting of two 36-foot spans, two 40-foot spans and two 9-foot cantilevers, all on concrete bents with timber pile foundations. This bridge, which is located in a four-lane section of highway, provides for a 56-foot roadway.

The bridge across Dos Pueblos Creek was built under a separate contract and was completed on March 28, 1941. This reinforced concrete structure consists of one 60-foot and two 50-foot spans on concrete piers and abutments. The bridge provides for a 27-foot clear roadway.

LOCAL BORROW DEPOSITS

The base material for the cement treated base and the mineral aggregate for the plant-mixed surfacing, as well as a portion of the material for the imported borrow was secured from a local deposit in the Arroyo Quemado, located 4 miles from the westerly end of the Orella Project and 10 miles from the westerly end of the Tecolote Creek Project. The contractor set up his plant in this location and supplied the materials for both contracts.

The project between Tecolote Creek and Las Varas Creek will cost approximately $260,000. The construction of the bridge over Dos Pueblos Creek cost approximately $21,200. The contract between Orella and 1 mile west of Canada del Refugio cost approximately $200,000 including the bridge over Refugio Creek.

J. C. Adams has been the Resident Engineer for the State on the road construction and E. C. Bissell was the Resident Engineer on bridges.

Feather River Flood Did $2,086,000 Damage

(Continued from page 5)

Use of this pump, in addition to natural drainage is hastening the dewatering process.

In addition to the damage caused by the flood in Sutter County, other portions of the Sacramento River Flood Control Project were weakened by wave wash, slips and erosion.

The Division of Water Resources prepared a report on the extent of the flood for presentation to the Congress in support of U. S. Engineer Corps recommendations for improvements to the Sacramento River Flood Control Project. The report declares:

FEDERAL AID IMPERATIVE

"It is imperative that appropriations in the amount of $4,000,000 be made by the Congress for expenditure between July 1, 1942, and June 30, 1943, in order to assure continued essential agricultural production and to afford adequate protection from floods to two transcontinental railroads, two main line railroads to the Pacific Northwest and many highways of great importance in connection with war production activities."

Fifteen sections of Sacramento River Flood Control Project levees which are in need of heightening and enlarging are listed in the report by the division. In addition funds are required for bank protection, revetment, levee setbacks and dredging.

The automotive industry annually uses 380,000,000 pounds of cotton, 16,640,000 pounds of wool, 2,800,000 bushels of corn or its equivalent, 590,000 bushels of flax, 12,500,000 gallons of molasses, 2,000,000 pounds of castor oil, 1,500,000 gallons of soybean oil and 800,000 gallons of tung oil.—*The Trail*, December, 1941.

A shady business never yields a sunny life.

Problems of Highway Maintenance Arising Out of the War

(Continued from page 13)

work as clearing or cleaning of culverts, ditches and gutters, mowing grass, spraying and burning weeds, removal or trimming of trees and brush and maintenance of drinking fountains and parking areas is also included.

The only item in the list which can apparently be definitely discontinued is the mowing of grass. The work on other items may be reduced in certain areas and in degree of performance at other points.

The care of roadside trees and shrubbery, to mention a relatively small item, requires about 2 per cent of the maintenance funds. These plantings are intended primarily to improve the appearance of the roadsides, but they also serve to protect cut and fill slopes from erosion. While a certain amount may be saved if maintenance is less intensive, the major part of the annual expenditure must be continued if the investment is to be perserved.

Over a period of 20 years and more a generally high standard of maintenance has been established for the entire State Highway System. The public generally has come to expect that, barring acts beyond the control of man, the highways will be in safe usable condition at all times. It is generally accepted that failure of the organization to meet such expectation may involve claims for damages in event an accident occurs not only against the State, but against individuals in the organization.

There is certain to be a reduction in revenue available for State highway purposes. It is unlikely, however, that the corresponding reduction in traffic volume or weight will occur in like degree on the State highway. In fact if the war effort is to be successful, it may be expected that heavier traffic will occur. In any event the through routes must be kept in condition for emergency moves of the military forces at any time.

In the face of the standard of work carried on in the past, the effect of continued heavy use by defense traffic on obsolete surfacing, and the needs of strictly military traffic, there is little prospect of radical reduction in demands for highway maintenance.

In Memoriam

LESTER C. MEDER

The California Division of Highways and particularly the Materials and Research Department suffered a severe loss when Assistant Physical Testing Engineer Lester C. Meder passed away from a heart ailment on Saturday, February 7, 1942.

Mr. Meder was born in Carson City, Nevada, October 8, 1901, and received his early education in the Carson City schools. He graduated from the University of California in 1931, receiving the degree of B.S. in the College of Chemistry. Prior and subsequent to his college work he was connected with the National Bureau of Standards both at Denver and San Francisco, being engaged primarily in cement testing and investigational work.

In September, 1933, Mr. Meder accepted a position with the Materials and Research Department of the California Division of Highways with which department he remained until his untimely death cut short a career in which he was rapidly establishing a reputation as a portland cement research specialist.

While with the department he was the recipient in 1938 of the Wason Medal for notable research from the American Concrete Institute for joint authorship with Thos. E. Stanton of the paper on "Resistance of Cements to Attack by Sea Water and Alkali Soils."

He was the author of a series of articles published in the April, May, and June, 1940, issues of California Highways and Public Works, dealing with the development of cement through centuries of experiment dating back to early Assyrian, Egyptian, Grecian and Roman periods and progressing to the present day portland cement.

He played a prominent part in the studies conducted by the department during recent years which led to discovery of the cause of the failure of concrete in many concrete pavements and other concrete structures in some areas of the State as described in an article on the "Expansion of Concrete Through Reaction Between Cement and Aggregate" published in the December, 1940, and September, 1941, Proceedings of the American Society of Civil Engineers and was one of the contributors to a series of papers on the same subject just published in the January, 1942, Journal of the American Concrete Institute.

The State has lost a valuable employee, one who will be exceedingly difficult to replace.

Bids and Awards for February, 1942

KINGS COUNTY—About two miles southeast of Corcoran, a timber bridge across Sweet Canal to be constructed. District VI, Route 135, Section B. F. Fredenburg, So. San Francisco, $7,577; Geo. Von KleinSmid, Bakersfield, $8,289; E. G. Perham, Los Angeles, $9,189; Kiss Crane Service, Berkeley, $9,282; Geo. E. France, Visalia, $9,645; Trewbitt-Shields, Fisher, Fresno, $10,398; Dan Caputo, San Jose, $10,759. Contract awarded to M. E. Whitney, Bakersfield, $7,194.

LOS ANGELES COUNTY—Traffic signal system furnished and installed on East Third Street, between Indiana Street and Bonnie Beach Place, District VII, Route 172, Section A. Econolite Corp., Los Angeles, $8,590. Contract awarded to Pacific Union Marbelite Co., Los Angeles, $8,345.

LOS ANGELES COUNTY—Traffic signal system furnished and installed on East Third Street, between Bonnie Beach Place and Atlantic Blvd., District VII, Route 172, Section A. Pacific Union Marbelite Co., Los Angeles, $8,995. Contract awarded to Econolite Corp., Los Angeles, $8,780.

RIVERSIDE COUNTY—At the Keen Camp Maintenance Station, about 22 miles east of Hemet, a water supply well to be drilled and cased. District VIII, Route 64, Section N. Contract awarded to Coe Machine Works, San Bernardino, $2,391.

SANTA CLARA COUNTY—Between Bascom Avenue and Race St., about 1.2 miles in length, storm sewers to be constructed. District IV, Route 5, Sections B, SJ's. John Pestana, Oakland, $26,872; Dan Caputo, San Jose, $27,788; A. J. Raisch, San Jose, $27,858; Edwin J. Tobin, Oakland, $29,818; McGuire & Hester, Oakland, $29,856. Contract awarded to Earl W. Heple, San Jose, $24,589.

SANTA CRUZ COUNTY—At Wilder Creek, Little Baldwin Creek and Coja Creek, a total length of about 1.3 miles, to be graded and surfaced with road mixed surfacing. District IV, Route 56, Section B. Parish Bros., Sacramento, $103,872; R. L. Oakley, Pasadena, $145,584. Contract awarded to Granite Construction Co., Watsonville, $91,749.

"Keep 'Em Rolling" a Slogan for Motorists

America's wartime slogan to motorists—"Keep 'Em Rolling"—has a new significance when the absolute need of automobile transportation in some sections of the nation is studied, it is pointed out by the Automobile Club of Southern California.

In the United States, a total of 2,320 cities and towns with a combined population of $12\frac{1}{2}$ million, are without any form of local mass transportation, and are entirely dependent for passenger transportation upon the automobile. Another 872 cities which do have transportation are served only by buses.

The best way to save daylight is to use it.

Scene at a San Diego intersection where a single automatic signal keeps four streams of traffic rolling

Automatic Signal Controls 3,000 Cars An Hour At Four-Way Intersection

By R. B. LUCKENBACH, District Traffic Engineer

THE installation of full traffic actuated signals, at the junction of Pacific Highway (U. S. 101) and Rosecrans Street in the City of San Diego, approximately one year ago, has provided a service which is efficiently handling peak hour traffic exceeding 3,500 vehicles an hour. This installation has caused much favorable comment from the traveling public and traffic officers, as it controls the traffic with a minimum of friction and a high degree of safety.

The topography of San Diego makes it difficult to provide sufficient main traffic arteries, consequently the principal intersections carry large volumes. Improvement of the Pacific Highway, the main route to Los Angeles, in 1938 and later the Mission Valley Road connection to the Pacific Highway on the east with a subsequent improvement of a westerly connection at the same intersection, resulted in serious congestion and several accidents.

DESIGNED BY STATE ENGINEERS

Traffic data were secured and designs for the signal system and channelization were made by the Division of Highways in the Fall of 1939, which resulted in the installation being completed by a local contractor January 1, 1941.

Peak hour counts of traffic entering this intersection from all directions have been taken as follows:

	Cars
Sunday, November 5, 1939	1,837
Monday, November 6, 1939	850
Saturday, June 15, 1940	1,011
Sunday, January 19, 1941	3,683
Sunday, February 2, 1941	3,710
Sunday, March 9, 1941	3,433
Thursday, April 17, 1941	3,122
Sunday, September 14, 1941	3,470

During this time numerous 15-minute counts have also been taken on Sundays, showing volumes of 950 to 1,086 vehicles. At the present time, 30-minute volumes occasionally exceed 2,000 vehicles and would be larger except that an adjacent intersection restricts the flow.

The intersection is complicated by heavy turning movements between the northerly, southerly, and easterly legs of the intersection. There are relatively few turns to and from the westerly leg. Congress Street, which is the fifth leg of the intersection, is a dirt road which had a very low volume, seldom exceeding 50 vehicles per day, and no provision was made in the original installation for controlling it, although the system can be extended to provide control later.

Considering the four heavy legs of the intersection, there are normally 12 entering movements of traffic to provide for. After eliminating the four right turns, the remaining eight were studied and it immediately became evident that three separate time intervals would be necessary to eliminate the major conflicts.

After careful study of the approach angles, a three-phase sequence was adopted which provided a minimum of conflict and still permitted almost continuous use of the intersection area. Also an additional lane was added to each approach with a separate left turn lane for the southbound left turn movement. The sequence is indicated on the intersection diagram as phases A, B. and C.

The use of a merging left turn with the heavy through traffic, as shown on

To our knowledge, no similar installation was in operation, at that time, in the western United States.

The controller assigns right of way in accordance with the constantly varying demands of traffic which are registered by the detectors. This constant adjustment of time interval tends to produce maximum intersectional efficiency at all times, including hours of lighter volume, as it permits continuous use without idle time, and will go from any interval to either of the other two if no demand is on the intervening phase.

TRAFFIC DEMAND GOVERNS

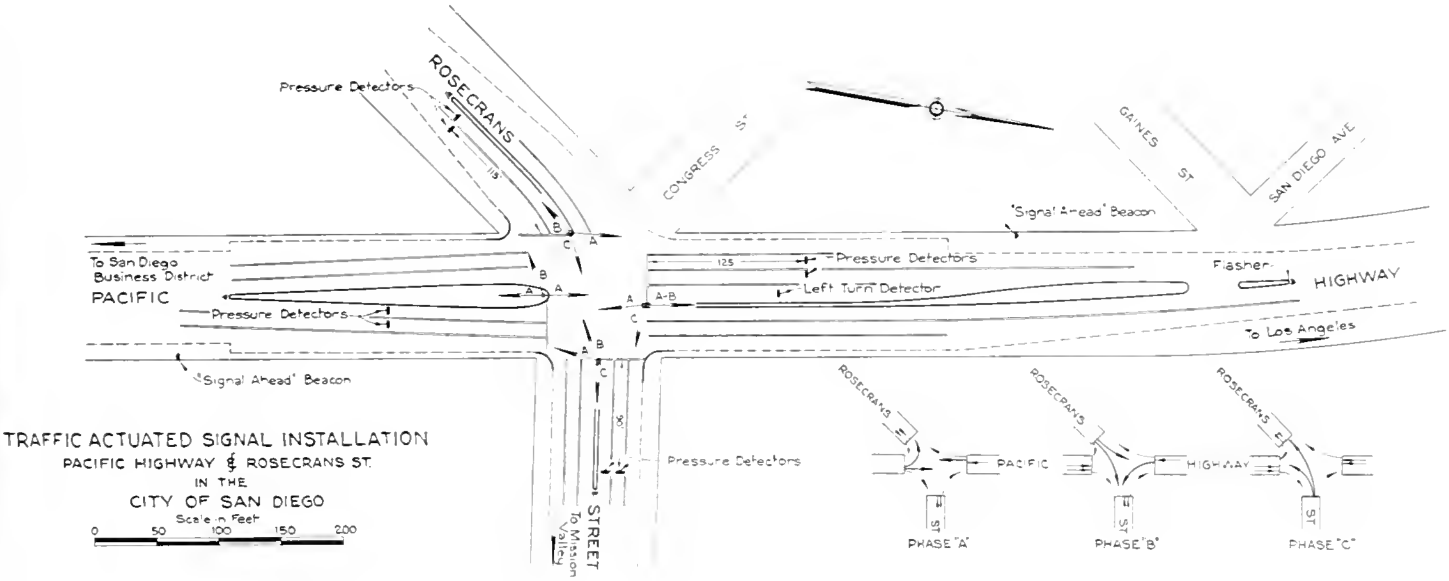
Right of way is not given to any street, without traffic demand thereon, and in the complete absence of traffic,

which operates from each detector impulse. After the initial interval has expired, each impulse cancels the time in effect and starts a new time period.

MAXIMUM INTERVAL 25 SECONDS

This feature causes the traffic to yield the right of way when the vehicle spacing exceeds a predetermined time. The controller is at present adjusted for nine to 10 seconds minimum and 25 seconds maximum for each of the three phases which after adding the amber light time gives a total cycle of 35 to 85 seconds.

Under reasonably uniform traffic distribution, the system will handle 3,000 vehicles per hour on a cycle of 50 to 55 seconds with a smaller cycle



Sketch showing locations of advance traffic detectors and channelization islands that efficiently control movement at busy intersection

phase "B," is one of the unusual features which has proved very successful.

THREE-PHASE SYSTEM

A full traffic actuated three-phase dispatching system was selected as being the best available to give the desired results. The high degree of efficiency for all traffic volumes and the very favorable public reaction to full actuated control indicates the additional expense of such an installation was justified.

The system consists essentially of three parts, namely the detectors, which register the vehicles entering the intersection; the controller, which is the brain of the system; and the lighting units, which indicate the right of way to the motorist.

the go signal will remain where it was last assigned unless otherwise adjusted for preference to a particular street.

Demand on one street when the right of way is on the other causes right of way to be transferred only after a minimum adjustable interval has elapsed and after proper clearance interval as follows:

Immediately, providing there has been no demand on the other streets.

After an adjustable maximum interval despite continued demand on the other street.

The timing mechanism operates on the static principle without motor or clock and provides for an adjustable initial interval sufficient to clear stopped cars plus a vehicle interval

for lower volumes. As compared to usual three-phase systems, this is a very high efficiency and is largely attributable to the full actuated principle of operation which on that particular location probably increases the intersection's capacity 50 per cent over other available types of control.

A traveler at a small hotel ordered two boiled eggs for breakfast.

The waiter who served him brought three.

"Here," said the traveler, "why have you brought me three eggs? I only ordered two."

"Yes, sir," said the waiter, smiling, "but one of them might fail you."

Pet—"Don't you think, darling, that your new overcoat is a bit loud?"

Darling—"Never mind, pet. I'll wear a muffler with it."—Smith's Weekly.

Designing Foundation Courses for Highway Pavements and Surfaces

(Continued from page 8)

furnished by Table 3 consist of the *average gross weight* per sampled vehicle, the *average axle weight* and the *average number of axles* per vehicle. The first two are not used in determination of design requirements, being informative only. The third or last figure is used in determining the number of commercial vehicle axles during any particular period; in this case a 10-year period.

Table 4 represents a page from the tabulation, which supplements the data shown in Table 3, showing the axle weights by 1,000 pound increments and the percentage for each weight group of the commercial traffic actually sampled at each of the loadometer stations. In other words, it represents a cross-section of the commercial traffic passing through the particular loadometer station and is considered as typical of the probable weight distributions actually using that section of highway.

The axle classifications A, B, etc., are standard classifications which have been adopted to indicate whether the sampled vehicle is a truck, truck and trailer, truck and semitrailer or any of the various other combinations of commercial vehicles in common use.

"WEIGHTED" FACTORS

Table 5 is copied from page 60 of "Reinforced Concrete Pavements" by Royall D. Bradbury as discussed above.

Table 6 shows: (1) the induced stress from Table 5; (2) the equivalent wheel load, which conforms to the group adopted for the form for computation of equivalent repetitions; (3) the numbers representing the equivalent repetitions divided by the actual repetitions as secured from Bradbury's tabulation; (4) the multipliers of each preceding figure; and (5) the factors adopted for use in the form for computation of equivalent repetitions.

A uniform multiplier of *twice* the preceding factor has been adopted. This results in a considerably lower total than would be secured if Bradbury's figures for portland cement concrete pavement were followed exactly. The factors are, of course, arbitrary, but have been adopted only after several years of observation and correlation of all types of surfacings and pavements subjected to known volumes and weights of traffic, and, in our opinion, represent a reasonable compromise applying to all types of surfacing. Indeed, in view of the assumptions which must necessarily be made to arrive at definite figures, we believe the factors chosen are proving thoroughly practical as a basis for design of highways in this State. Moreover, it must be realized that Bradbury's figures refer to the number of repetitions of a given load required to induce the *first crack*, while from the practical standpoint, we are concerned with evaluating the more severe condition of definite slab failure.

DESIGN STANDARDS

On the basis of these computations, we have tentatively adopted the following highway design standards, based on total estimated number of wheel load repetitions over a 10-year period:

1. HEAVY INDUSTRIAL TYPE

(10,000,000 equivalent wheel loads or over): Outside traveling lanes to consist of 0.92 foot-0.67 foot-0.92 foot portland cement concrete pavement; or 0.75 foot-0.50 foot-0.75 foot lower cement content portland cement concrete base surfaced with asphalt concrete 0.25 foot thick. Inside or passing lanes to consist of 0.75 foot-0.58 foot-0.75 foot portland cement concrete pavement; or 0.58 foot-0.42 foot-0.58 foot lower cement content portland cement concrete base surfaced with asphalt concrete 0.25 foot thick.

2. MEDIUM INDUSTRIAL TYPE

(2,500,000 to 10,000,000 equivalent wheel loads): All lanes to consist of 0.75 foot-0.58 foot-0.75 foot portland cement concrete pavement; or 0.58 foot-0.42 foot-0.58 foot lower cement content portland cement concrete base; or cement treated base varying in thickness from 0.50 foot to 0.75 foot in accordance with number of wheel loads and other conditions, with bituminous surfacing 0.25 foot thick; or asphalt concrete pavement of adequate strength where subgrade is suitable and wheel load repetitions are under 5,000,000.

3. LIGHT INDUSTRIAL TYPE

(less than 2,500,000 equivalent wheel loads): Pavement to consist of 0.75 foot-0.60 foot-0.75 foot asphalt concrete or some combination of local base materials surfaced with bituminous mixtures as the equivalent repetitions decrease below the top limit designated above, the design necessarily being subject to various local conditions of traffic and materials.

(Note.—Figures 0.75 foot-0.58 foot-0.75 foot indicate pavement slab 0.58-foot thick, increasing to a thickness of 0.75 foot in a distance of two feet at each edge of each lane.)

Naturally, our weighted "fatigue factors" and other instruments of design will be subject to modification in other States, inasmuch as they are affected by the average flexural strengths secured in concrete pavement as well as the severity of the climate and other factors which induce large stress increments to add to the direct load stress.

It is particularly gratifying to record that in the actual application of this method of evaluating the probable destructive elements of traffic, the computed measure of service in terms of wheel load repetitions is proved with astonishing accuracy by the condition of the existing facility, especially if the design has been less than the standards now considered adequate.

We feel confident that, as far as California conditions are concerned, the methods outlined above constitute valuable tools, rough though they may be, to help determine more accurately the conditions for which we must design.

California Has Low Auto Tax Rate

California motorists are reported to be enjoying the lowest per-vehicle special tax cost in the Nation. The average cost per vehicle for fuel tax and registration fees in California last year was $22.99, while Florida tops the list of States with $67.70.

"Well, I think I'll put the motion before the house," said the chorus girl as she danced out onto the stage.

State of California
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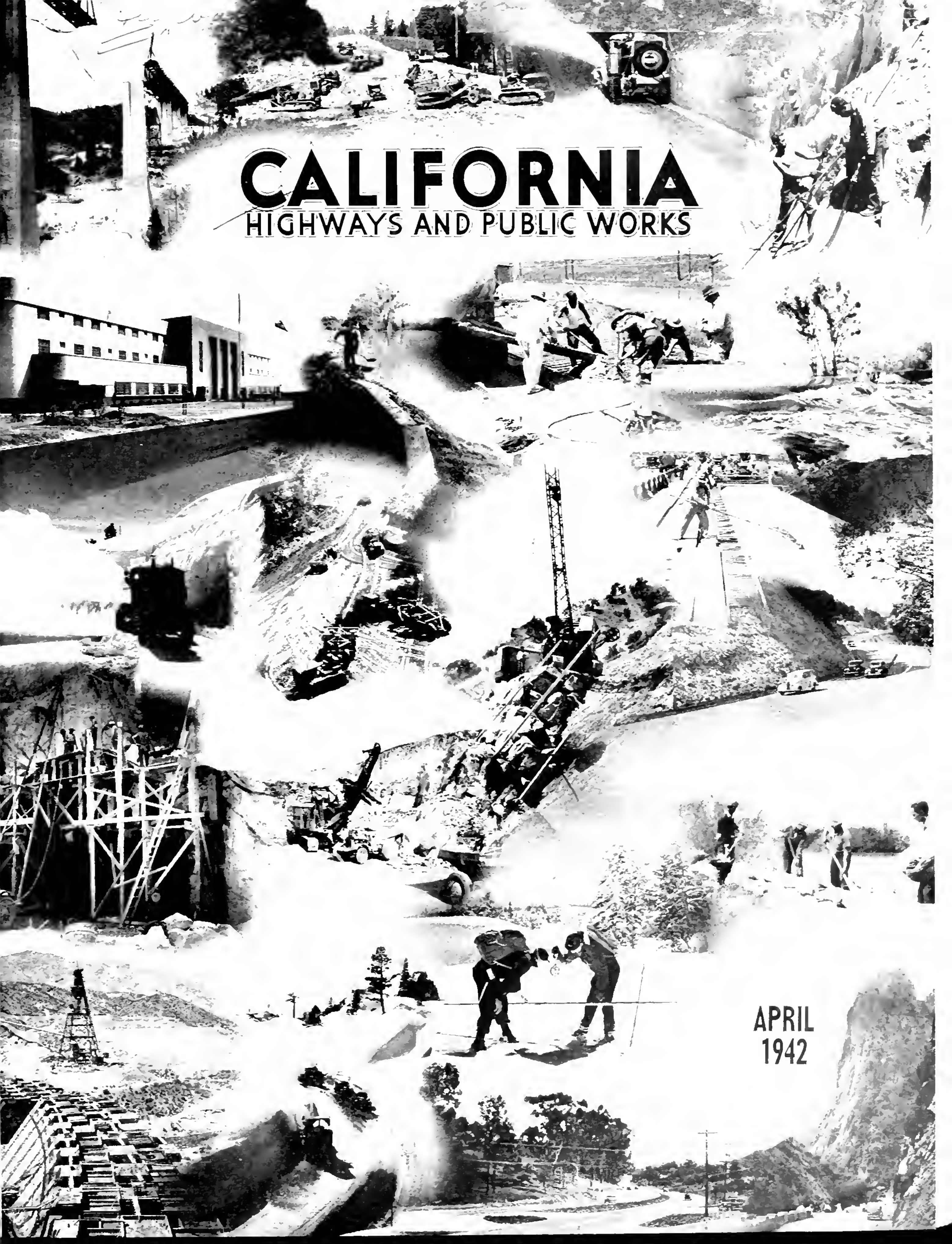

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FRANK W. CLARK, Director C. H. PURCELL, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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Vol. 20 APRIL, 1942 No. 4

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Shasta Dam Power and Plans For Its Marketing

The following article comprises an address by Charles E. Carey, Senior Engineer in charge of Power Administration of Central Valley Project made before the California Water Project authority and some of the discussion that ensued. Mr. Carey is considered one of the outstanding authorities in this country on public ownership and distribution of power. He has established headquarters in Sacramento to organize a public market for Central Valley Project Power.

Mr. Carey was employed as general consulting engineer and acting administrator for the Bonneville Power Administration, having served successively as rate engineer, principal construction engineer and acting supervisor.

Mr. Carey's experience with electrical engineering extends back to a professorship with the University of New Mexico where he taught the subject for three years. He left the teaching job to become general engineer for the Westinghouse Electric & Manufacturing Co., and later the company's engineering supervisor for the Pacific Northwest.

In 1935 he entered the Federal service as assistant district engineer for WPA, and served as consulting engineer for the National Resources Committee at Portland and supervisor of the Division of Operations for the WPA.

COMMENTING at a meeting of the Water Project Authority of California on the action of the Appropriations Committee of the House of Representatives of Congress in deleting approximately $15,000,000 for construction of Central Valley Project transmission lines and a steam plant at Antioch, Mr. Carey, representing U. S. Bureau of Reclamation, expressed this encouraging opinion:

"The recent action of the Appropriations Committee, of course, is rather disturbing to me. I do not believe that in the long run it will have any effect on the Central Valley Project. Somehow or other, I feel that those transmission lines which are an essential and integral part of this development will be built by the Federal Government. They are so essential and so important to the success of the whole project that it seems to me they can not be overlooked."

MARKETING HIS PROBLEM

Mr. Carey, who is in charge of the marketing of Central Valley Project power for the Bureau of Reclamation, attended the meeting of the Authority at the invitation of the chairman, Director Frank W. Clark.

Addressing himself to the Authority members, Mr. Carey revealed that the offer of the Pacific Gas & Electric Company to purchase all power generated at Shasta Dam and at Keswick has been turned down by the Department of the Interior.

The Authority will be represented in Washington when the matter of an appropriation for transmission lines and the Antioch plant is taken up by the Senate. Every effort will be made to have the deleted appropriation items restored.

Expressing his views on the Washington situation as it affects the Central Valley Project, Mr. Carey said:

CHARLES E. CAREY

"We who have followed the power development on the Pacific Coast have repeatedly said that the agency which controls and operates the transmission systems naturally controls and operates and sets all the policies of the power within the territory which it serves. That is why it is rather important to certain interests and certain people that the Federal Government does not construct transmission lines.

"I am very happy to be with you people. I am very happy to work with you on a problem of marketing power in the territory in which, when the position was offered to me, I said the most attractive part of it was that it was a challenge to anybody who has ever been in the power game—and it certainly is.

"As I see this picture, gentlemen, I think it is exactly as you see it. The water of this valley—and when I say 'water' I mean water in all of its uses—is to be put to work to produce the maximum prosperity of the region. That means water for navigation, water for irrigation, water for industrial and domestic use, and the concomitant power.

"That is quite a task, but it has been done elsewhere and it can be done here. How to do it is a problem which I am trying to solve and to which I hope we will have the answer before long. Incidentally, that is my first function: to try to set a pattern and program for the Department of the Interior and the Bureau of Reclamation so that goal of maximum prosperity for the region can be reached. That means, incidentally, the lowest cost for water and the lowest cost for power for the ultimate consumers in this territory.

POWER CREATED PROSPERITY

"Gentlemen, I naturally see power from a viewpoint somewhat different from most of you. I have recently come here from 20-odd years' experience in your neighbor States. I have seen power create a new economy in Oregon and Washington in a period of months. I have seen low-cost power from the Columbia River go into that territory and an economy which was based upon forest and forest products and upon agriculture, change, inside of 12 months, to an economy of the future which will be based upon light metals and new metals and hard metals.

"Because of the low-cost power in that territory we are seeing a new empire being created on the coast. We are seeing new industries come in there, industries which will produce and manufacture aluminum, magnesium, ferro-chrome, ferro-silicon, calcium carbide, new chemicals, new fertilizers of phosphorous.

COULEE AND BONNEVILLE

"We have seen, gentlemen, the so-called white elephants of the Columbia River—and people said there was no use for the power—we have seen the time come inside of a few months in which not only was all the power which they could generate put to work but there was a cry and a demand that all of the generators in Coulee and Bonneville be installed as rapidly as possible. We have seen in a period of 18 months the first power from Bonneville being delivered and at the end of 18 months we have seen firm, definite contracts for power totaling over 700,000 kilowatts, with a continuous output of somewhere in the neighborhood of about 350,000 kilowatts, which was the total amount of generating capacity then installed. And above all, we have seen the most rapid rise in the increase of the consumption of power that has ever taken place anywhere in this Nation or any place else. In the State of Washington alone it has increased in a period of 12 months by an amount greater than 52 per cent in kilowatt hours.

"That has been the result of two things: of a carefully planned program of having power available, and the second one is having a rate structure, a cost of power, that would attract the industries into that territory. I could tell you in a lot of detail what these industrial plants are; I could tell you in a lot of detail what this whole power program has meant up there.

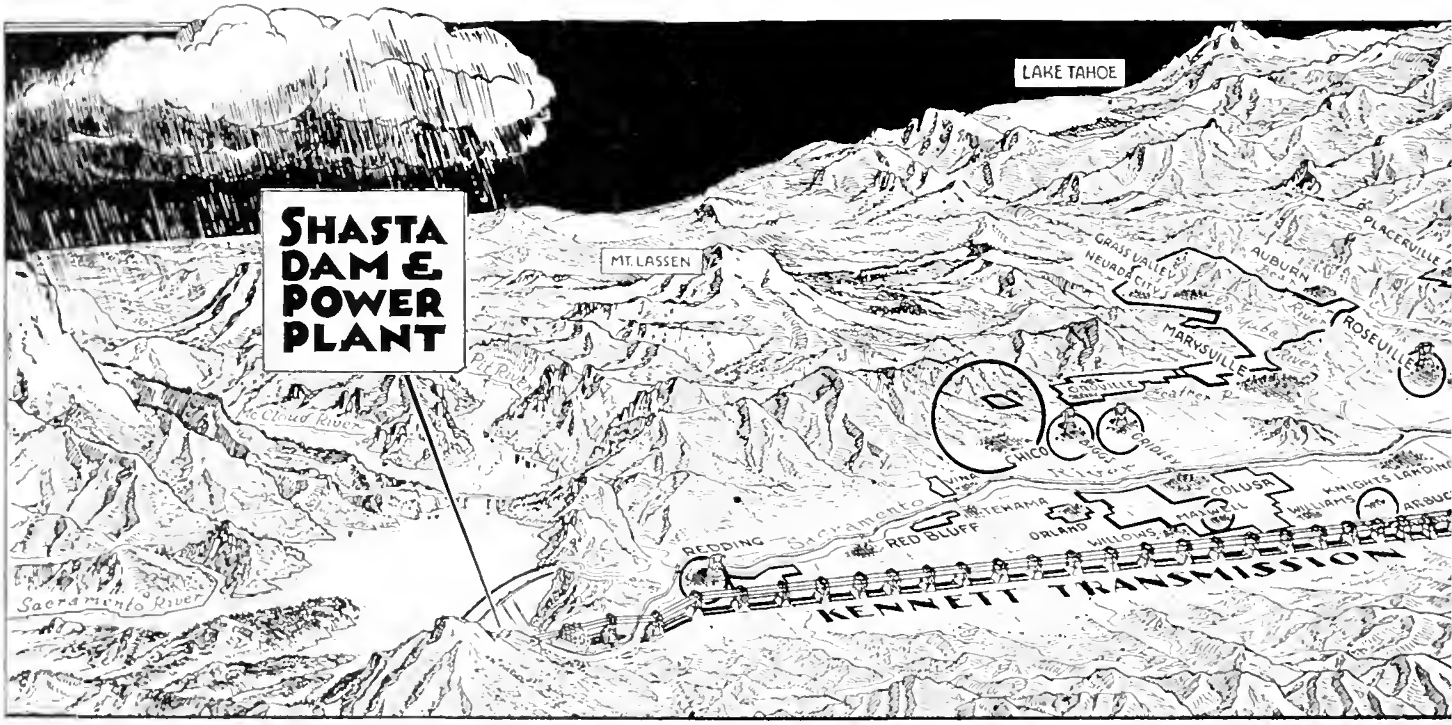
"If nothing else, it has meant a new economy. It has meant the beginning of a new industrial expansion in Oregon and Washington and on the Pacific Coast, and, above all, it means permanent jobs for 10,000 or 15,000 people. When I say 'permanent,' I mean just that, because those of you who will translate the cost of energy in kilowatt hours to the cost per pound of aluminum, magnesium, and many of these basic materials, will find that one mill difference in the cost of energy per kilowatt hour means one cent or $1\frac{1}{2}$ or $1\frac{3}{4}$ cents per pound in the basic cost of aluminum or magnesium or synthetic rubber. For that reason the low-cost power in that territory will maintain and sustain and keep the so-called war plants in operation long and continuously after this war emergency is over.

"There is another part of this power program that is important, and that is you individual consumers and you people who use either water or power are entitled to receive those facilities at the lowest possible cost. The record to the north and the south of you, places where the program of multiple-purpose projects has been carried out continuously, and aggressively, in order to accomplish the goal, shows an ever-increasing use of energy in the home; and along with it we have found a rapidly decreasing cost of that energy.

"The entire States of Oregon and Washington during a period from 1933 to 1940 have enjoyed continually decreasing rates for electric energy, and the savings which have resulted from these rate reductions which were made by the public systems, and likewise the private systems, are now amounting to approximately $9,000,000 per year. That does not consider any power that was delivered by Bonneville and Coulee. The influence of those plants and the policies which went into effect were worth better than $9,000,000 a year to those two states.

MILLIONS SAVED PUBLIC

"Now, gentlemen, in a territory in which the power facilities, the number of people, and the policies are quite similar to the Central Valley Project, you have a pattern and you have a possibility of what the power



Sketch Map of Central Valley Project Water and Power Features Showing Public Agencies and

program can and might do in this territory. I am quite sure the people in this territory can use a saving of $9,000,000 a year, regardless of where it comes from, the saving in power bills and what-not, because after all that saving in power means that you merchants and you people who have other things to sell find that that money goes back to the merchants and the other people of the community, either for homes or for other commodities.

"As I say, I see this power picture perhaps in a different light than a lot of you people because I have approached it, gentlemen, as an engineer sees power at work, power doing things and power making things and power reducing the costs of everything that we use. In order to accomplish that, there must of necessity be a policy behind the marketing of that power which fulfills a fundamental principle, namely, that the power from these public works projects must be made available to the ultimate consumer at the lowest possible cost.

"That, I think, states broadly the principles of marketing the power in the Central Valley so far as I am concerned. I am sure it states broadly the principles of the Department of the Interior and the Bureau of Reclamation, and it certainly is in line with the legal regulations which were set up in the Reclamation Act of 1939.

"To the members of this board I wish to say I am very happy to be with you this morning and I am very happy to work with you."

Concerning hearings held in Washington by the House Appropriations Committee, Chairman Clark, Carey, State Engineer Edward Hyatt and Attorney General Earl Warren, member of the Authority, engaged in a discussion which proved interesting as evidenced by the following transcript of what they said:

Mr. Carey: As I recall, Mr. Abe Fortas did explain pretty much the negotiations which were under way. While in Washington, if my memory serves me correctly, Mr. Hyatt and Mr. Ely and two other gentlemen were advised of the conferences and pretty much of what the conclusions were, about what had been discussed.

Mr. Hyatt: That is right.

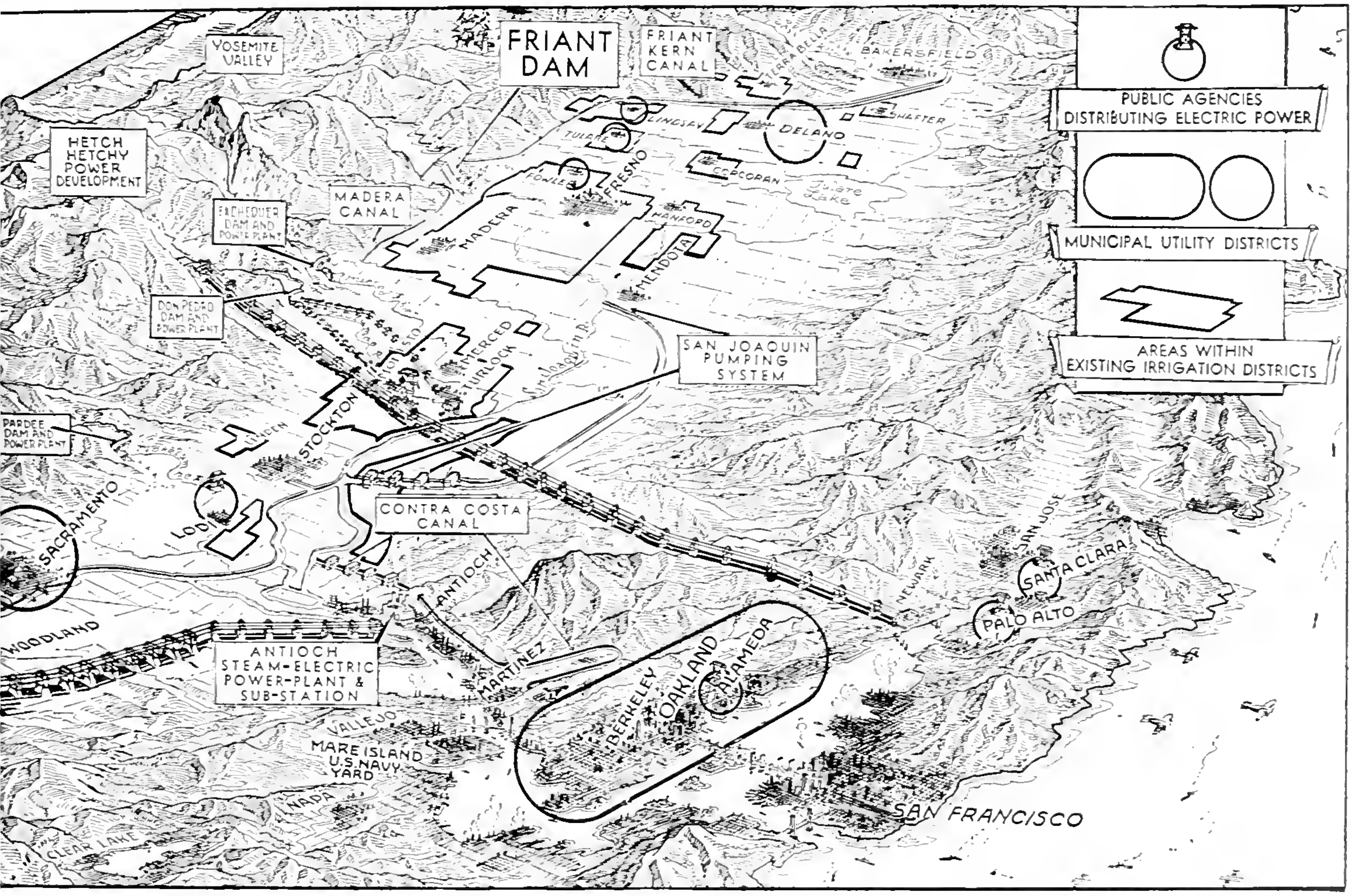
Mr. Carey: You were advised prior to any official notification to the Pacific Gas & Electric Company that for the time being we felt it was in the better interest of the Government to proceed with the construction of transmission lines and steam plants which were essential and integral parts of the Central Valley Project, rather than to enter into a contract for power at this time which would give the Pacific Gas & Electric Company almost exclusive and monopolistic rights to Federal power, and you concurred in our conclusion.

Mr. Hyatt: That is correct. Mr. Carey, in the first place, this offer was not in writing?

Mr. Carey: That is right.

Mr. Hyatt: So it was not the subject of detailed analysis. Now, this is getting into some technicalities which Mr. Mathew perhaps had better take up, because it is covered in his testimony here; but in analyzing the offer as best we could from the verbal statements we do not find it is anywhere near as good an

(Continued on page 7)



ned Irrigation and Electric Facilities Which Can Be Linked to the Vast New Sources of Supply

Additional Traffic Lane Added to U. S. 40
3-Lane Sections Where Traffic Is Heavy

By C. F. PRICE, Resident Engineer

DUE to increased activity at industrial plants and the decrease in toll charges on the Carquinez Bridge in September, 1940, traffic on U. S. 40 highway, between Oakland and the bridge, has increased approximately 100 per cent in three years. A large percentage of this increase has been experienced within the last year.

Prior to 1933, this was a two-lane highway carrying approximately 1,800 vehicles per day. In 1933, due to a normal traffic increase, the pavement was widened to three lanes. Late counts indicate traffic has now increased to 15,000 vehicles per day, of which more than 10 per cent is composed of trucks and buses.

This large increase of traffic has overtaxed the present facility and has necessitated the immediate addition of another traffic lane at locations where sight distance or driving visibility is inadequate for safe driving of high speed traffic interspersed with heavy trucks and buses.

There are a number of locations on this road where, because of the hilly topography, there is poor sight distance due to blind vertical curves over summits approached by steep grades, horizontal curves with short radii, or a combination of the two conditions. The worst of these conditions on this route are located at what is known as Tank Farm Hill and also at Oleum and Selby.

The summits at these locations are approached by grades varying from 3.5 per cent to 7.0 per cent, and due to trucks ascending them at slow speed, all traffic, being confined to two traffic lanes on account of the hazard in passing, is retarded to a snail's pace.

The project now in progress consists of widening the existing 30-foot pavement to a 40-foot width to provide four 10-foot traffic lanes over Tank Farm Hill and from Oleum to the Carquinez Bridge a total length of 3.53 miles. This is accomplished on most of the project by adding a 5-foot strip on each side of the present pavement. At Oleum, a change in alignment has been made to improve sight distance, which required additional right of way. Here, a new full width 40-foot pavement is being constructed on 1,000 feet of new alignment.

To match the existing pavement with the 5-foot widening strips, two types of construction were necessary. One type consists of Class "B" portland cement concrete 7 inches thick on a 4-inch crusher run base, and the other consists of 2 inches of asphalt concrete on 6 inches of Class "B" portland cement concrete. The whole project is to be flanked on both sides by borders 3 feet wide, composed of 8 inches of crusher run base with an armor coat surface.

At Oleum, large industrial plants are located. Plant vehicles used in the daily routine of operation frequently cross back and forth and in addition many trucks enter and leave the premises in the transport of supplies, equipment, etc. These vehicles, added to the hundreds of cars used by employees who daily drive to and from work, have created a very congested and dangerous situation at this location, both from the standpoint of main highway traffic and the local traffic.

Added to this hazard is the grade of the highway in front of the main driveways, which approximates 6 per cent. To improve this hazardous condition to highway traffic, accelerating and decelerating lanes are being added to the 40-foot pavement.

The Valona intersection at the south approach to the Carquinez Bridge is to be channelized by constructing a triangular traffic island, consisting of 6-inch concrete curbing.

Future plans provide for extending this widening program to include all of the mileage between the metropolitan East Bay area and the Carquinez Bridge, with four lanes of pavement throughout, which when completed will further relieve the heavy traffic flow and congestion on this important highway link.

The present project, when complete, will materially increase the capacity, reduce delay, and improve traffic safety on this road.

Highway System Is Crucial Cog in Our Defense Production

America is at war! Today, in the words of War Production Board Chairman Donald M. Nelson, "We have just one job to do—to make enough war material to lick Hitler and the Japs and to do it in the shortest possible time." This will require the total mobilization of every military, industrial and human resource of the country.

Crucial cog in the machinery of defense production is the National Highway System. Over the streets and highways of America now roll materials vital to the construction of planes, tanks, ships, guns and the other supplies needed to make the United States truly the arsenal of democracy.

Cars and buses each day carry thousands of defense workers to their jobs and home again. Farm-to-market roads and main highways unite to transport food for these workers and for our armed forces as well. One firm, for example, uses trucks and trailers to haul 64,000 pounds of produce to Fort Sill, Oklahoma, every week.

Army convoys, which contain as many as 1,000 or more trucks, motorcycles and passenger cars, move soldiers and Army supplies across the country. On the efficiency of the Nation's roads and bridges depends the speed and safety with which these essential men, machines and materials can be moved.—*Charles M. Upham in Highway Information Service.*

Three busy sections of U. S. 40 recently transformed from a three-lane to a four-lane highway

New Santa Paula Lateral Unit Eliminates 30 Curves in 6 Miles

THE secondary State highway between Ventura and Castaic Junction serves as lateral connection in southern California for two north and south trunk highways. This lateral leads easterly through the fertile valley of the Santa Clara River, passing through the cities of Santa Paula and Fillmore and the town of Piru.

During the past five or six years the Division of Highways has been conducting an extensive reconstruction program along this entire route, replacing the poorer sections with modern units as rapidly as available funds would permit. On January 20, 1942, the Director of Public Works accepted the most recent of these units in Ventura County, across the sloping debris cones and river bottom between Piru Creek and the Los Angeles County line, a distance of 5.7 miles.

OLD ROAD INADEQUATE

As the alignment and grade of the old road at this location, constructed by the county in 1916, were entirely inadequate for present day traffic, reconstruction necessitated complete revision.

The contract for this project involved the construction of a graded roadbed 36 feet wide and the placing of portland cement concrete pavement 22 feet in width on a selected material subgrade. Shoulders, with bituminous surface treatment, were constructed 7 feet in width on each side of the new pavement.

The degree of improvement to the highway accomplished by this latest project may be gauged by comparison of the alignment of the old and new roads. On the old route there were 42 curves in the five miles between the termini of the project, while there are only 12 curves on the new alignment. The sharpness of curvature on the old road is shown by the fact that of the 42 curves, 12 had radii from 1,000 to 500 feet and 19 had radii of 500 feet or less, with a minimum of 160 feet. The minimum radius on the new line is 1,300 feet.

NEEDED FOR LIBRARY

Altadena, California

California Highways and Public Works
P. O. Box 1499
Sacramento, California

Gentlemen:

For some time I have had intermittent opportunities to read your publication. I have derived considerable pleasure and no small amount of benefit from your excellent articles. Each issue that I have seen has strengthened the conviction that I need a file of this magazine in my own reference library.

Can you put me on your mailing list, and may I have a copy of the November, 1941, issue.

Thank you.

Very truly yours

Charles Albert Smith,
Civil Engineer,
Altadena, California.

MODERN BRIDGE INCLUDED

Construction operations involved movement of 230,000 cubic yards of material in roadway excavation and channel change, 15,500 cubic yards of Class "B" portland cement concrete, in which was used 108,000 pounds of bar reinforcing steel and 47,000 pounds of wire mesh reinforcement.

Included within the limits of this construction project, but built under a separate contract, was a modern reinforced concrete slab and girder bridge across Piru Creek about one-quarter of a mile easterly of the town of Piru. The bridge is 880 feet long and consists of seventeen 50-foot spans and two 15-foot cantilever spans.

This new structure replaced the 30-year old, narrow steel truss located on old and dangerous alignment about 2,000 feet upstream from the new crossing. As the modern bridge crosses an alluvial fan near the confluence of Piru Creek and the Santa Clara River, it is of necessity much longer than the old structure.

216 PILES IN FOUNDATION

Materials used in construction of the bridge included 2,489 cubic yards of portland cement concrete and 510,000 pounds of bar reinforcing steel. The 216 piles driven for foundations required 4,360 lineal feet of piling.

The bridge contract was awarded by the Director on July 7, 1939, and completed on March 25, 1940.

The road construction contract totaled $282,200 and the construction cost of the bridge was $85,300. The projects were financed with both Federal and State funds. The road contract was performed by the firm of Fredericksen and Westbrook of Sacramento and J. S. Metzger and Son were the bridge contractors.

At the present time bank protection work is under way along the Santa Clara River near this completed improvement at about four miles easterly of Piru. This work includes construction by State forces of rock and wire mattresses, slope paving, and sacked concrete riprap.

A contract is also in progress for construction of 20 steel rail tetrahedrons. These measures will provide protection to the roadway from flood waters of the Santa Clara River during the flashy winter storms to which this section is subject.

5,000,000 Trucks Now In U. S.

When the United States entered World War I in 1917, there were on the highways only 326,000 trucks—largely truck bodies on passenger car chassis. Today there are about 5,000,000 trucks in use in this country. These have a total hauling capacity estimated to be 50 times greater than the capacity of trucks in use in 1917.

Earnestness is enthusiasm tempered by reason.

Above pictures show portions of old and new road on realignment of a State Highway lateral eliminating curves between Castaic and Ventura

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(Continued from page 3)

offer as the committee was led to believe it is. That is, it was that offer that really defeated this appropriation, in my opinion, or was one of the main items, anyhow.

Mr. Carey: That is correct.

Mr. Hyatt: Now, they said that was a firm offer. Our investigation there in Washington, based on verbal statements only, because we had no copy of any document, led to the conclusion that the offer was predicated on a method of operation which the bureau under the law might not be able to carry out. Therefore, this offer, while it might have been very effective in defeating the appropriation, if and when it is to be translated into a document later on, as you all know, there will be plenty of difficulties come up. That is, this guarantee may never eventuate at all. It served a wonderful purpose in defeating the appropriation, but whether it is ever translated into something is something else again.

Now, as I say, we were under some difficulty in analyzing an offer which was not in writing in an effort to defend that appropriation. That is, we could have defended the appropriation a lot better if we had been a party to the discussions of the offer.

Mr. Carey: Well, the transcript of the hearing was available, Mr. Hyatt.

Mr. Hyatt: So I understand. I did not see it. I guess Mr. Matthew did.

Mr. Carey: Yes, it was available. After all, the principal discussions of the particular offer that was made contained—or, rather, I should say, were more or less around the general policy by which power might be purchased from the Federal projects and marketed by either the Pacific Gas & Electric Company or any private or public utility.

The most important part of those discussions, Mr. Chairman, came when the question was asked, "Will you deliver power over your system to any customer of the Federal Government?" and the answer was "No" by Mr. Black.

In answer to another question, "Will you pass on to the ultimate consumers

(Continued on page 8)

Diagonal White Bars Mark Warning Areas At Medial Separations

PUTTING traffic "down the groove"—making it easier to do the right thing and undesirable or even difficult to do the wrong thing is traffic engineering. The easier a change in traffic movement is brought about or mobility obtained, the better is the engineering.

In locations of heavy traffic, the divided or separated highway is fast becoming the desirable construction. Where these sections lead from and into narrower roadways—frequently two-lane pavements—a transition area must be provided. The California Division of Highways is making it easier for the motorist to do the right thing at such spots by the construction of stream-lined medial divider ends.

Using raised plant-mix bars, painted white with traffic lacquer and set at an angle of 45 degrees to the traffic flow, a long pointed segment is constructed gradually separating opposing traffic to the constructed width of the separating area, which is frequently 20 feet or greater.

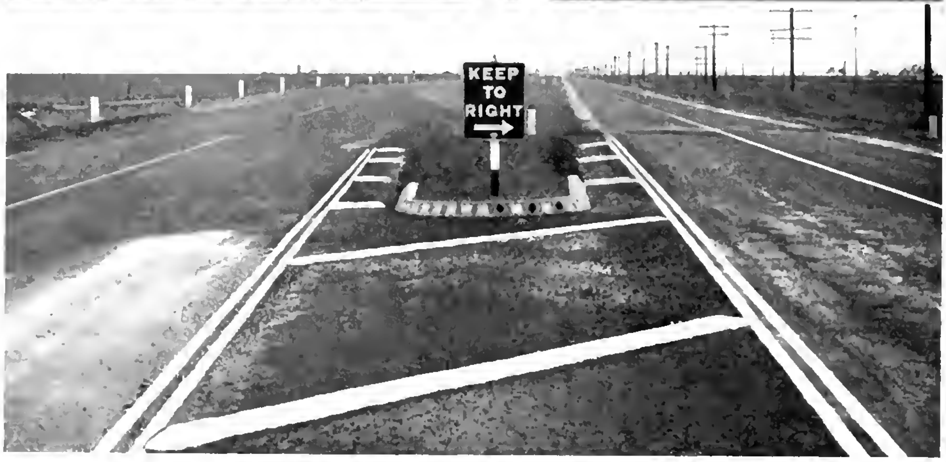
One hundred feet or more from the point of maximum width, the point of the separating end divider is laid. From this point, gradually lengthened bars are placed to form an advance warning island of medial separation. Standard double traffic stripe eases the traffic from the two-lane pavement to the separated roadway.

To give the line greater night visibility, the stripe is reflectorized with glass beads. To increase the visibility of the bars these, too, are often glass-beaded. Bars are 6 inches to 8 inches in width and increase in height from $\frac{3}{4}$ inch to three inches from the point to the maximum width of the island. Bars are placed from 5 feet to 20 feet apart.

The divider is further marked with a standard reflectorized "KEEP TO RIGHT" sign.

Daughter (talking to her mother): "And our Domestic Science professor is teaching us how to spend money."

Father (interrupting): "The next thing we know they will be trying to teach ducks how to swim."



Raised white plant-mix bars prove effective channelization aids at medial divider ends

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(Continued from page 7)

any saving in the cost of electric energy which might accrue for power which you purchase from the Federal plants?" the answer was indefinite and to the extent that that would have to be considered and passed back through other channels, but no commitment and no promise was made.

POWER AT LOW COST

Therefore, in line with the general policy that has been set up—that power from these plants must be made available to the ultimate consumer at the lowest possible cost and at as near a non-profit basis as possible—the conferences, so far as the purchase of this power was concerned, crystallized very quickly on those two answers, and all of the technical detail and all of the study of water power in the picture, gentlemen, was just background, that is all.

Chairman Clark: It is significant, though, that Mr. Hyatt is of the impression that the committee was influenced by, and in my opinion probably certain members of the committee were justified in the position that they wanted to take by being fortunate enough in having this supporting data, and that evidently it was of such a nature that it influenced the outcome. I think that is very important.

Mr. Hyatt: This report here says that evidence was given by one witness that an existing power agency would be willing to purchase the entire supply of power generated at Shasta Dam at a fair profit to the Government. That is the statement in the committee's report, that they had evidence to that effect. Now, I am not sure that that alleged offer guaranteed anything of the kind because the limitations as to operation which were therein contained might have brought about a different answer; but, in any event, there was plenty of room for argument.

FAIR PROFIT?

Mr. Carey: As a matter of fact, Mr. Hyatt, I believe the offer was at a fair

(Continued on page 9)

Leonard D'Ooge New Administrative Assistant in Public Works Department

LEONARD D'OOGE

EQUIPPED for his new duties by many years of experience in Public Relations and the manufacturing business, Leonard D'Ooge has been appointed Administrative Assistant to Director of Public Works Frank W. Clark.

Born in Ypsilanti, Michigan, Mr. D'Ooge, after attending grade schools in the city of his birth, graduated from high school and from the Manlius Military Academy in Manlius, New York, and then completed courses in Michigan Normal School, Michigan State College and Northwestern University.

Upon leaving college Mr. D'Ooge was associated with the Buick Motor Company of Flint, Michigan, and following the outbreak of World War I, was called to Washington, D. C., where he served under Secretary of War Newton Baker in War Camp Community Personnel Service. After the war he was for a time purchasing agent of Dodge Brothers Motor Company of Detroit, and then entered business for himself in Detroit as a manufacturers' agent handling structural steel, electric travelling cranes and foundry equipment and supplies.

He disposed of his sales agency in 1922 and engaged in advertising and sales promotion in Chicago until 1933, when he came west. He first entered State service in structural work on the San Francisco-Oakland Bay Bridge. Following this assignment he accepted Civil Service appointment under the California Commission for the Golden Gate International Exposition as Assistant Exhibit Coordinator. He organized the Agricultural and State Mining Exhibits on Treasure Island and in addition showed that he has better than average artistic ability by winning a state art contest and having one of his water colors hung in the art exhibit in the State Building. Early in 1940 he founded the Leonard D'Ooge & Associates Advertising Agency in Oakland, which he relinquished to accept Director Clark's appointment.

Mr. D'Ooge's father, Dr. B. L. D'Ooge, was an American scholar of renown and author of many nationally used Latin and Greek text books. Mr. D'Ooge and his family have established a residence in Sacramento.

Shasta Power Marketing

(Continued from page 8)

profit, but I don't think the fair profit would be to the Government.

Chairman Clark: That is what I am thinking about, the fair profit to the Government. After all, this project is for the benefit of the people of California, is it not?

Mr. Carey: That is right.

Mr. Warren: Mr. Carey, am I entitled to infer from what you have said that the department has rejected the offer of the P. G. & E.?

Mr. Carey: Yes, certainly for the time being. Gentlemen, this war program has been of such a nature, moving so fast, that it did not seem to be the part of wisdom on the part of the department to make any commitments of power two years in advance of which it would actually be ready, when it could actually be delivered, and if the war closed in the morning we did not care to have any commitments for delivering the power. There was a situation out here in which we would have a post-war program that would have to be solved and power would play an important part in rebuilding the Central Valley area, the same as water plays an important part. We felt that that should be kept unencumbered and free to be programmed as it should be programmed.

Motorists of U. S. Can Save $62,000,000 in Gas Bills at 40 M. P. H.

MOTORISTS can increase their tire mileage by 20 per cent and also save 5 per cent on gasoline by reducing their driving speeds to 40 miles an hour as recommended by President Roosevelt to State Governors, the Public Roads Administration announces. In his letter the President emphasized particularly the need for conserving tires.

By a further reduction in speed to 35 miles an hour, it is estimated by PRA that an additional 20 per cent in mileage from tires and a saving of another 5 per cent in gas can be obtained.

On the average, a used tire that is serviceable for another 10,000 miles under normal driving on rural highways, will go 12,000 miles if the speed never exceeds 40 miles an hour, or 14,000 miles at a speed of 35 miles an hour, according to the estimates.

Studies of gasoline saving show that on the basis of normal automobile mileage, motorists would save about $62,000,000 on their gasoline bills by reducing driving speeds to a maximum of 40 miles an hour, or about $97,000,000 at maximum speeds of 35 miles an hour.

Movement to Reduce Speed Spreading Over Nation

The movement launched in California to bring about voluntary reduction of driving speed to conserve cars and tires and promote safety is to become a campaign of nationwide scope.

Action was taken by the executive committee of the American Automobile Association, in a meeting at Washington, D. C., to carry the slower driving appeal to more than a million motorists organized in 750 affiliated A. A. A. clubs.

Herb (writing to dealer)—"Sir, send me two mongeese."

He did not like the looks of this, tore it up and began again—"Sir, send me two mongooses."

This also failed to please him, so he wrote—"Sir, please send me a mongoose; and, by the way, send me another."

Report on Construction Projects And Pavement Records for 1941

The following annual report by the Construction Department of the Division of Highways, giving details of pavement construction in 1940, is eagerly awaited both by the contractors and State engineers connected with the various projects, who evince a keen competitive interest in the records of average daily concrete yardage laid, strength per square inch, per cent variation in cement control, asphalt tonnage, and roughness index per mile.

By EARL WITHYCOMBE, Assistant Construction Engineer

THE Standard Specifications governing all types of construction carried on by the Division of Highways were revised and reprinted as of July, 1940, and became effective on the projects constructed during 1941. A great many changes were made in construction procedure as well as quality of materials, and represent the accumulated opinions of field forces, Materials Laboratory, and Construction Department, gained from personal experience with the various problems involved.

In advance of the redraft of these specifications, invitations were sent out to the field forces suggesting participation in the discussion of specification requirements. Each individual was given an opportunity to offer his suggestions through the agency of the 11 highway districts, with Sacramento Headquarters acting as coordinator. Contrary to expectation, there was a marked unanimity of opinion on most of the controversial features of specification requirements.

These specifications have been in effect throughout the 1941 construction year and have proven of general benefit to the various projects. Contributions are continually being made toward a further perfection in construction procedure and are being carried in special provisions for the individual projects until such future time when the Standard Specifications may again be revised.

CEMENT-TREATED BASE

The latest contribution to pavement design is the development of the cement-treated base construction. This consists of a road-mix or plant mix of native or low cost imported material with cement and water. The cement content is usually specified within a three point range between 5 and 10 per cent by weight of dry aggregate, and is predetermined from laboratory tests of material proposed for use. A compressive strength of 1,000 pounds per square inch at 28 days is considered the minimum advisable with this type of construction.

A considerable mileage of this type was constructed in 1941, and although most of the mixing was performed by plants of the pug mill type suitable for mixing both base and surface, one project was specified by the road-mix method, a Gardner type mixer being used for this purpose with very gratifying results.

The material consisted of disintegrated granite, and was imported from a nearby source. The surface was scarified and pulverized for the cement treatment to a depth of 0.5 foot and a width of 24 feet. This width was divided up into 8-foot sections and the required amount of cement laid out in bags end to end down the center of each section.

Just prior to mixing, the bags were emptied and the edges of the scarified material thrown up over the loose cement to form a windrow. The windrow was given one dry mixing, followed by two mixings with half the specified amount of water applied each trip through the mixer. This method gave a very satisfactory mix with good uniformity.

Mixtures are designed by laboratory methods fabricating the specimens in a mold under a pressure of 2,000 pounds per square inch. The optimum moisture content is determined for the material to be used and is offered as a field guide.

Maximum consolidation and maximum strengths go hand in hand in this type of construction. A deficiency in moisture gives low compaction and resulting low strengths, and excessive moisture for similar reason results in low strengths. Excessive moisture is evidenced by jellying of the mixture which makes rolling impossible and is readily identified. **The most satisfactory moisture condition for the type of compaction equipment being used is that moisture just short of producing the jellying condition.**

The most satisfactory method so far developed for spreading the mixture is by means of a bulldozer equipped with side wings and wheel mountings on forward corners to maintain a constant height above the subgrade.

ROLLING PROCEDURES

The first rolling is given immediately behind the spreading operation, and the surface is either lightly scarified and shaved with a heavy drag spanning the full width of the compacted surface, or shaved with a motor grader.

Following this, the consolidation is completed and the final rolling with pneumatic-tired equipment is carried out with the addition of a fine spray of moisture to the surface in the amounts necessary to correct any surface lamination and to give a uniform surface texture.

As quickly thereafter as practicable, the curing seal is applied, consisting of approximately 0.2 gallon per square yard of penetration-type asphaltic emulsion. Traffic is normally barred from the freshly laid base for a period of seven days, although it has been necessary in a few instances, for the sake of expediency, to permit traffic to use the base continuously immediately following the laying and without any noticeable detrimental effect.

Speed in laying is essential with this type of construction, the best compaction results being obtained by consolidating as soon as possible behind the spread. Samples are cut from the compacted base and the weight per cubic foot determined by measuring the size of the hole with dry sand. The specifications require that the field compaction shall be not less than 95 per cent of the results

A 23-foot portland cement concrete pavement for one-way traffic on a recently completed divided highway section of U. S. 101

obtained by consolidating a specimen in a steel cylinder under a load of 2,000 pounds per square inch.

Strengths that are being obtained with this type of mixture are very gratifying. Cores were taken from five of the largest projects constructed last season at ages ranging from three to seven months after construction. Results, calculated on the basis of L/D ratio equals one, averaged for each project 710, 970, 2,155, 2,190, and 2,400 pounds per square inch, respectively. The two projects averaging strengths less than 2,000 pounds were constructed with material containing practically no coarse aggregate; those above 2,000 were constructed with run of bank sand and gravel approximating a good concrete grading.

The practice has been to top these bases with either asphalt concrete or plant-mix. Experience has demonstrated that the surfacing should not be less than two inches in thickness for satisfactory results, a lesser thickness being too susceptible to displacement under traffic.

PORTLAND CEMENT CONCRETE

With the shortage of sacks, bulk cement was used to a greater extent than in previous seasons. Automatic proportioning devices for cement and aggregate have been considerably simplified and difficulty in operation is much less common.

No change has been made in the design of $\frac{3}{4}$-inch expansion joints at 120-foot intervals, with weakened plane joints at 15 feet, except on experimental projects where this interval was varied. One project has sheet metal strips submerged in the surface in place of the normally edged weakened plane joint, and this pavement was the smoothest recorded for the season. Redwood joint material is being used almost exclusively.

With one exception all projects were constructed with 5-sack concrete, this exception being a 6-sack design.

Construction Records

The highest *average daily output* of portland cement concrete pavement was by Fredericksen & West-

PORTLAND CEMENT CONCRETE PAVEMENT RECORDS FOR 1941

Location	Contractor	Resident Engineer	Street Assistant	Average cu. yds. laid per day	Average strength, 28 days, lbs. per sq. inch	Per cent average daily variation in cement	Roughness index, inches per mile
Redding Underpass—Hill Street	Fredericksen-Westbrook	F. Drinkhall	A. Bigelow	349	4265	0.72	13.8
South Fork Putah Creek—1 mi. E. of Davis & Swingle—Yolo Causeway	Fredericksen-Westbrook	J. W. Corvin	W. J. Braker	520	3467	1.48	8.6
1 mi. East of Davis Subway—Swingle	Fredericksen-Westbrook	J. W. Corvin	W. J. Braker	485	4379	1.06	10.7
Llagas Creek—Gilroy	N. M. Ball Sons	H. S. Payson	H. A. Hart	445	3193	.70	5.8
At El Camino Real & University Avenue	Union Paving Company	H. S. Payson	H. A. Hart	218	4496	.80	20.8
2.6 miles north of Capistrano	Griffith Company (S.Fe R.R.)	C. Gildersleeve	H. D. Johnson	334	5703	.80	7.5
Piru Creek—Los Angeles County Line	Fredericksen & Westbrook	E. L. Seitz	W. T. Lamb	680	4027	.93	6.7
Keyes—Hatch Crossing	M. J. B. Construction Co., & F. Kaus	R. H. Lapp	J. C. Witherell	605	4468	---	4.5
0.5 miles north of Ash Slough—Dutchman Creek	M. J. B. Construction Co., & F. Kaus	R. H. Lapp	A. J. Hull	425	4505	.62	5.0
0.6 miles north—2.3 miles north of Route 208	Heafey-Moore, & Fredrickson-Watson	A. K. Nulty	G. R. Barry	229	4630	.73	10.0
Ballast Point—Upper Cantonment	Daley Corporation (WPA)	L. H. Williams	W. C. Cattell	292	2814	.87	16.0
			Averages	460	3840	.87	7.8

This section of four-lane divided highway of modern design is paved with both asphaltic concrete and portland cement concrete

brook on Contract 27XC7, road VII-Ven-L.A-79-C,A, Piru Creek to Los Angeles County line, where an average of 680 cubic yards per day with a 34-E paver was maintained. E. L. Seitz was resident engineer, and W. T. Lamb, street assistant.

The average daily output for the entire State in 1941 was 460 cubic yards as compared to 374.3 cubic yards in 1940. The increase in output is largely due to the specified 20 per cent permissible overload in a paving mixer permitted under the new standard specifications.

The highest average *compressive strength* for 5-sack concrete during 1941 was 4,630 pounds per square inch on Contract 410TC2, road X-Sol-Nap-7-G,A, 0.6 mile north to 2.3 miles north of Route 208; Heafey-Moore & Frederickson-Watson, contractors, A. K. Nulty, resident engineer, and G. R. Barry, street assistant. The average for the State for 28-day compressive tests was 3,840 pounds in 1941 as compared to 4,204 in 1940.

The record for *cement control* was made on Contract 410TC1, Road X-Mad-Mer-4-C,A, 0.5 mile north of Ash Slough to Dutchman Creek, where the average variation was 0.62 per cent. M. J. B. Construction Company & F. Kaus were the contractors, R. H. Lapp, resident engineer, and A. J. Hull, street assistant. The average variation for the State in 1941 was 0.87 per cent as compared to 0.93 per cent in 1940.

The record for *surface smoothness* was made on Contract 210TC9, road X-Sta-4-A,Cer,B, Keyes to Hatch Crossing, with an average roughness index of 4.5 inches per mile. M. J. B. Construction Company & F. Kaus were the contractors, R. H. Lapp, resident engineer, and J. C. Witherell, street assistant. The average smoothness for the State in 1941 was 7.8 inches per mile, as compared with 7.4 inches in 1940, which indicates a slight decrease in riding quality.

ASPHALT CONCRETE PAVEMENT RECORDS FOR 1941

Location	Contractor	Resident Engineer	Street Assistant	Average tons laid per day	Average stability of surface mixture in %	Roughometer index, inches per mile
2.3 miles north—1.2 miles south of Petaluma	Louis Biasotti & Son., & L. D. Tonn	F. W. Montell	G. W. Levier	697	33.3	11.9
Llagas Creek, Gilroy	N. M. Ball Sons	H. S. Payson	H. A. Hart	428	44.0	11.2
Broadway—Charter Street	Piazza-Huntley, & Trewhitt, Shields & Fisher	L. G. Marshall	G. A. Wildman	747	34.0	15.5
At El Camino Real & University Avenue	Union Paving Company	H. S. Payson	G. L. Beckwith	502	34.1	23.5
Selma—Fowler	Piazza & Huntley	F. W. Howard	T. W. Voss	231	41.1	9.2
Foothill Blvd., Las Lomas Ave.—Irwindale Ave.	J. E. Haddock	J. R. Rubey	J. R. Rubey	525	47.0	21.8
Fairfax Ave.—La Brea Ave.	Oswald Bros.	G. H. Lamb	R. W. Anderson	443	37.6	19.9
0.6 miles north—2.3 miles north of Route 208	Heafey-Moore & Fredrickson-Watson	A. K. Nulty	G. R. Barry	352	40.3	18.6
Sandy Beach—Truckhaven	Basich Bros.	W. T. Rhodes	S. M. Templeton	590	37.6	22.3
			Averages	508	37.0	14.9

BITUMINOUS TREATED SURFACES—RECORDS FOR 1941

PLANT MIX

Location	Contractor	Resident Engineer	Roughness Index, Inches per Mile
Scotia—1 mile north of Rio Dell	A. Soda & Son	C. M. Butts	42.1
Heagney's—0.5 mile north of Lanes	N. M. Ball Sons	R. Bergroth	38.3
North Fork—Keddie	Hemstreet & Bell	C. A. Potter	16.2
Likely—Cedar Pass	Harms Bros.—Powers & Patterson	H. K. Ward	19.3
Bailey Hill—Oregon State Line	Parish Bros.	R. E. Halter	31.4
Red Bluff—6 miles north	Jones & King	E. J. Peterson	12.6
Redding Underpass—Hill St.	Fredericksen & Westbrook	F. N. Drinkhall	17.5
Constantia—Route 21	Fredericksen & Westbrook	H. B. Milner	9.3
Beckwourth—Edes Ranch	Poulos & McEwen	G. Sundman	8.0
Lincoln—Yuba County Line	Hemstreet & Bell	E. Hay	26.6
Homewood—Tahoe City	Independent Construction Co.	E. L. Miller	19.5
Woodland—Cache Creek	A. Teichert & Son	W. G. Remington	16.3
Cache Creek Bridge—0.4 mile north	L. Biasotti & Son	W. G. Remington	19.5
1 mile east of Davis Subway—Swingle	Fredericksen & Westbrook	J. W. Corvin	15.3
Baxter's—Hampshire Rocks	Hayward Building Matls. Co.	H. O. Ragan	18.9
Grove St. Tahoe City—3 miles west	Independent Construction Co.	E. L. Miller	12.4
Across Hancut Creeks	Engineers Ltd. & Parish Bros.	E. Hay	42.1
2.5 miles north of Cloverdale	Heafey-Moore & Fredrickson-Watson	H. A. Simard	12.4
San Rafael-Richardson Bay Bridge	A. G. Raisch	W. A. Rice	33.6
Prunedale Junction—Sargent Overhead	Heafey-Moore & Fredrickson-Watson	H. S. Payson	29.9
Lake Lucerne—2 miles south of Tunitas	N. M. Ball Sons	C. F. Price	43.9
Rockaway Beach—Edgemar	A. Teichert & Son	H. A. Simard	28.9
Llano Road—Wright Station	L. Biasotti & Son	G. H. Heberling	50.2
Tecolote Creek—Las Varas Creek	Basich Bros.	J. C. Adams	14.4
At Miles Station	Gibbons & Read	V. E. Pearson	15.2
Orella—1 mile west of Canada del Refugio	Basich Bros.	J. C. Adams	17.8
1.7 miles south of McKittrick—Route 58	Fredericksen & Westbrook	D. G. Evans	25.3
Myrtle Ave. San Rafael—San Quentin Wye	A. G. Rasich	W. A. Rice	36.1
Cypress Avenue—Big Dalton Wash	J. E. Haddock	B. Frykland	10.5
At Mill School	J. E. Haddock	B. Frykland	10.0
Newport Beach Blvd.—Corona del Mar	Mittry Bros.	W. D. Eaton	22.4
Bellflower Blvd. 0.3 mi. S. of South St., Artesia Ave.	J. E. Haddock	G. E. Farnsworth	10.1
Bellflower Blvd. Spring St.—South St.	J. E. Haddock	G. E. Farnsworth	8.7
1.6 miles west of Saticoy	Griffith Company	W. A. Norman	12.8
22d Street—Lampson Avenue	Griffith Company	H. B. Lindley	23.3
Dracaea Avenue—Route 19	Oswald Bros.	R. A. Bergman	16.7
Route 19—Banning	Oswald Bros.	J. M. Hollister	12.5
Route 187—Banning	George Herz & Co.	G. E. Malkson	8.5
Riverside—3 miles west	Matich Bros.	E. A. Bannister	22.7
Keyes—Hatch Crossing	M.J.B. Construction Co. & F. Kaus	R. H. Lapp	17.3
0.5 mi. north of Ash Slough—Dutchman Creek	M.J.B. Construction Co. & F. Kaus	R. H. Lapp	33.1
Merced—Tuttle	J. A. Carson	A. H. Lund	17.3
Mission Blvd. W.—Pt. Loma Blvd.—Pacific Beach Drive	V. R. Dennis Const. Co.	F. D. Pearce	17.2
Sandy Beach Road—Truckhaven	Basich Bros.	W. T. Rhodes	26.0
Lakeside—1 mile north	State Forces (WPA)	L. H. Williams	20.0
		Average	19.3

ROAD MIX

Location	Contractor	Resident Engineer	Roughness Index, Inches per Mile
Likely—Cedar Pass	Harms Bros., Powers & Patterson	H. K. Ward	38.8
Crescent Mills—Greenville	Oranges Bros.	C. A. Potter	32.3
Weed—1.4 miles north	Parish Bros.	C. A. Potter	29.1
Viewland—Madeline	Harms Bros., Powers & Patterson	H. K. Ward	13.4
Calistoga—0.2 mile north	N. M. Ball Sons	H. A. Simard	42.3
Edgemar—Thornton	Piombo Bros.	H. A. Simard	50.0
Davenport—1.5 miles south	Heafey-Moore, Fredrickson-Watson	A. Walsh	51.4
Peachtree Valley—Mustang Grade	Harms Bros.	A. L. Lamb	13.5
Famosa—Woody Road—Deepwell Ranch	Griffith Company	D. G. Evans	12.6
San Luis Obispo Co. Line—0.2 mi. S. of Kings Co. Line	Griffith Company	R. Windele	121.7
Elsinore—Corona	Oswald Bros.	W. H. Crawford	15.6
Otey's Corner—Bishop	James E. Anderson	F. R. Pracht	26.2
Columbia Wye—Sonora	Johnston Rock Co.	A. K. Nulty	36.5
Mariposa—2 miles north	Valley Construction Co.	E. L. Craun	55.0
Jamestown—1.0 mile south	Dan Caputo	A. K. Nulty	46.7
Mountain Springs—3.6 miles east	Denni Investment Corp.	R. C. Payne	12.1
Oak Grove—0.8 mile north	Roland T. Reynolds	F. W. Stewart	8.6
Farallone—Rockaway Beach	A. Teichert & Son	H. A. Simard	35.1
At Montara Creek	N. M. Ball Sons	H. A. Simard	14.8
Hernden Ave.—1.6 miles N. of San Joaquin River	Fredrickson Bros.	L. Tresidder	22.7
		Average	29.4

Road mix on gravel base surfaces a relocated section of State Route 18 in a mountainous area

ASPHALT CONCRETE

Two projects during the 1941 construction season employed the type of bituminous finisher ordinarily used without side forms. On one project a wheel was mounted on the side of the box and the one side operated with the machine taking the grade off of a wooden side form, giving very good riding results. On the other project, no side form was used and the resulting roughness is considerably more than the average for the season.

It is not considered that the bituminous finisher without side forms is equal to the standard asphalt concrete finishing machine operating on side forms, in producing a smooth riding asphalt concrete pavement.

Asphaltic emulsion seal coats without a cover are becoming more popular for asphalt concrete, and are used to an even greater extent to cover bituminous-treated surfaces as an ideal type of seal to carry freshly laid surfacing through the winter without the raveling and pitting generally experienced with winter work.

The rate of application for asphalt concrete has been reduced to about one-twentieth gallon per square yard of surface. This is sufficient to add the necessary tension between the surface particles without leaving an excess on the surface.

Construction Records

The highest *average daily output* of asphalt pavement tonnage was laid on Contract 24TC8, road IV-S.M-2-RdwC, Broadway to Charter Street, where 747 tons per day were averaged by Piazza & Huntley & Trewhitt, Shields & Fisher; L. G. Marshall was resident engineer, and G. A. Wildman, street assistant. The average daily output for the State was 508 tons in 1941 as compared to 541 tons in 1940.

The highest *stability of surface mixture* was obtained on Contract 27VC5, road VII-L.A-9, G, Foothill Boulevard, Los Lomas Avenue to Irwindale Avenue, with an average of 47 per cent; J. E. Haddock, contractor, J. R. Rubey, acting as resident engineer, and street assistant. The average for the entire State was 37 per cent in 1941, as compared to 37.4 per cent in 1940.

The record for *surface smoothness* was secured on Contract 26TC2, VI-Fre-4-A,Fowler, Selma to Fowler, where the average roughness index was 9.2 inches per mile. Piazza & Huntley were the contractors, F. W. Howard, resident engineer, and T. W. Voss street assistant. The average for the entire State in 1941 was 14.9 inches per mile, which is the identical figure for the preceding year an unusual coincidence in surface smoothness records.

BITUMINOUS-TREATED SURFACES

The plant-mix type again predominated in 1941, about 73 per cent of the 222 miles of oiled roads listed herein being the plant-mix type.

Spreading machines were used on a greater number of projects during 1941 than was the case in 1940.

Construction Records

The record for surface smoothness on plant-mix of 8.0 inches per mile was obtained on Contract 42WC3, road II-Plu-21-G, Beckwourth to Edes Ranch, by Poulos & McEwen, contractors, with G. Sundman, resident engineer. The average for the entire State in 1941 was 19.3 inches as compared to 23.1 inches per mile in 1940.

The record for surface smoothness for road-mix was made on Contract 211XC1, road XI-S.D-78-E, Oak Grove to 0.8 mile north, with 8.6 inches per mile; Roland T. Reynolds, contractor, F. W. Stewart, resident engineer. The average for the entire State in 1941 was 29.4 inches as compared to 49.2 inches in 1940.

Witts—Young Spendleigh inherited a modest fortune from an aunt.

Dubbs—Has he gone through with it yet?

Witts—Not yet. So far he has succeeded only in going through the windshield of his new $5,000 car.

State Employees Go To Special Class in Welding Engineering

AN intensified five-day training course in welding engineering was held in Sacramento February 24th to 28th. This special course was brought to Sacramento by the combined efforts of the Sacramento Section of the American Society of Civil Engineers, the Sacramento Junior College and the Lincoln Electric Company. While the bulk of the 85 men attending the course were residents of Sacramento there were representatives from as far north as Chico, Modesto, the San Francisco Bay Area and Reno, Nevada.

Approximately 50 men from the State Bridge Department were regular attendants at the course and there were many present from the Divisions of Water Resources and Architecture.

The course consisted of morning and afternoon shop courses and evening lecture sessions. Identical shop sessions held each morning gave each man attending an opportunity to get the actual feel of welding by making a butt and T Weld.

The afternoon shop sessions were demonstration courses covering welding inspection, reclamation of work parts, and special problems in welding. Demonstrations were given of Non-Ferrous welding and designed methods for expansion and contraction.

In the evening lectures the designed theories on welding were outlined and stress and load conditions were shown by means of celluloid models, polarized light and slides.

The course was given by Mr. E. W. P. Smith, nationally known consulting engineer with the Lincoln Electric Company in conjunction with the Sacramento Junior College personnel.

The course was enthusiastically received by the Department of Public Works' Engineers as an opportunity to broaden their knowledge of welding engineering. Welding, of course, is playing a more prominent part than ever in modern construction.

The number of Department employees that paid their registration enrollment fee and attended this course again demonstrates the wide awake interest of State employees in "in training" education.

Group of State employees watching expert demonstration before welding engineering class

Los Angeles Gets $3,000,000 Quarter Cent Gas Tax Project

At a conference held in Los Angeles between Director of Public Works Frank W. Clark, Highway Commissioner Amerigo Bozzani, State Highway Engineer C. H. Purcell and members of his staff, and representatives of the City of Los Angeles, a list of highway projects within the city on which will be expended ¼ cent gas tax allocations, was approved.

The gas tax money involved is available to Los Angeles for construction work on State highways within the municipal limits.

The approved projects totaling approximately $3,000,000 were as follows:

Olympic Boulevard
Berendo Street to Western Avenue

Olympic Boulevard
Hoover Street to Menlo Avenue

Olympic Boulevard
Traffic signals

Cahuenga Pass
Riverton Avenue to Barham Boulevard

Cahuenga Pass
Highland to Barham

Figueroa Street
Neola Street to Buena Vista Terrace

Daly Street
Main Street to Pasadena Avenue

San Fernando Road
Delay Drive to Verdugo Road

Moorpark Street
At Tujunga Wash

San Fernando Road
Ensign Avenue to Burbank boundary

San Fernando Road
Branford Street to Truesdale Street

Sepulveda Boulevard
Sunset Boulevard to south of Waterford Avenue

Sepulveda Boulevard
Ohio Avenue to south of Pico Boulevard

Colorado Boulevard
Townsend Avenue to Eagle Rock Boulevard

Thanks Highway Crew

Honorable Culbert L. Olson,
Governor of California,
Sacramento, California.
Dear Governor Olson:

I just want to convey to you—with the hope that you will tell the men involved—how very much I appreciate the courtesy, cooperation and extreme kindness of the highway maintenance crew of three men who helped me recently when I had some trouble with my car.

This happened on the McGee Creek Ski Lodge Road, Inyo National Forest. They were most helpful and I am deeply grateful.

Very truly yours,

H. W. von Morpurgo
The Paraffine Companies, Inc.
San Francisco

Revision of Biennial Highway Program Indicated by $13,000,000 Estimated Reduction in Gasoline Tax Revenues

An estimated reduction of $13,000,000 in returns from the 3-cent gas tax in 1942 due to tire and automobile rationing and demands of the Federal Government for defense highway construction indicates a change in policy of highway administration in California and a possible further revision of the highway budget for this biennium.

This is the gist of a report prepared by State Highway Engineer C. H. Purcell and presented to the California Highway Commission by Director of Public Works Frank W. Clark.

During the past year the report says, the normal program of highway work has been restricted by regulations limiting allocation of Federal aid, involving military access and strategic roads and by increases in cost of work due to the labor, material and equipment situation. Developments such as tire and gasoline rationing and further increases in the Federal income tax, for example, will have a far more serious effect on the program.

STUDY UNDER WAY

A study is under way to determine the trend of traffic volume, the probable reduction in income and other factors bearing on future administration of highway work. It is too soon to determine with any certainty, the full effect of forces now in operation. It is quite evident, however, that revenue available for highway purposes will be reduced during 1942 and for an indefinite period thereafter. A reduction of $13,000,000 in returns from the three-cent State gasoline tax in 1942 as compared to an estimated revenue for a normal year is used, tentatively, for purposes of preliminary analysis.

The volume of automobile travel will fall off, the Purcell report predicts, but where such declines will occur is difficult to determine. The record of mid-February counts taken at points on the State highways shows an erratic pattern of gains and losses as compared to counts in February, 1941. On the whole, however, there was an apparent gain of 4.6 per cent for February, 1942. A certain undeterminated percentage of such traffic, however, is nonrevenue producing vehicles—principally military traffic. It seems probable that the volume of military truck and bus traffic on the State Highway System will increase as the war effort intensifies.

BUDGET REVISION

It is not too early, for purposes of preliminary programing of work for the current biennium, to consider the type of work and even specific projects which should be retained, reduced or abandoned. Consideration should also be given to projects which should now be added to the budget program as a result of changes in the financial and traffic situation.

REVENUE INADEQUATE

It is well known that revenue available for the State Highway System has been inadequate to meet requirements since 1933 when the mileage was doubled. It has been necessary to use a large part of the funds for improvement of highways within or immediately serving urban areas. Even here in many cases the quality of surfacing was sacrificed, stage construction was employed in order to finance improvement on the most desirable and permanent location. While this policy has been justified, it has had the effect of over-extending demands on maintenance funds for the entire period of the past nine years.

The surface on many of the secondary roads taken into the system in 1933 was inadequate either as to age, type, or width or even on all three counts. Under county control, maintenance had been neglected in many cases since the beginning of the depression period. In some instances, the counties applied a minimum oil treatment shortly before transferring the roads to the State to insure future maintenance as an oiled surface.

Through judicious selection of minor construction projects, some improvement was made. Reliance has been placed, however, on continuous restoration and patching of the existing surface from maintenance funds to keep the so-called 1933 secondary highways as well as the inadequate surfaces on the older State highways in passable condition. This surface condition frequently has been one of appearance only. When put to the test by any unusual combination of load and weather conditions, failures have occurred. The field forces are required to be constantly on the alert to guard against dangerous conditions which develop overnight. In other words, a large mileage of the highway system was in a state of incipient failure even before wartime traffic developed.

MAINTENANCE PROBLEM

The report "Highway Needs" shows that in 1938 some 1,760 miles of highway was inadequate as to type of surface, and a total of 6,055 miles was inadequate as to both width and type of surface for the existing traffic. There has been some reconstruction of surface in the interim, but in general the structural stability of highway surfacing has further deteriorated in the four years since the data were accumulated.

The Maintenance Department has reviewed its yearly program and the least essential items are being eliminated or standards reduced to conserve funds. The situation as to maintenance funds is complicated by several factors and any savings thus affected are taken up by extraordinary demands. For example, some $1,250 per day is spent in guarding bridges, maintenance stations, and powder magazines. Up to February 16th, these items cost over $100,000. There must also be considered such matters as, increasing difficulty and cost in securing materials and equipment and the problem of holding the organization or securing replacements for men who are called to the service or go into defense industries.

CHANGE OF POLICY

There are other matters which enter the picture, but it is believed that the considerations discussed point the way toward a change in policy in the administration of highway work in California. There is no question that the first duty is to maintain the road surfaces and structures on every important road in usable condition for defense and military activities during the emergency. There is the further duty of so planning the work as to carry along the sections having inadequate surfacing for a period of adjustment after the immediate emergency has passed. The problem then, is the determination of type and extent of work to be deferred.

The restoration work which should have immediate attention includes 14 projects on which resurfacing and strengthening is required. The estimated cost of the resurfacing and incidental work for these 14 projects is $1,271,700.

It should be kept in mind that these projects are only the most desirable or necessary at the moment and that others will be presented from time to time.

The most logical projects to be reduced or removed from the budget are (1) those for which priorities can not be secured for critical materials, (2) certain projects planned primarily to serve normal increasing traffic volumes, and (3) certain projects on the secondary road system which have little or no part in the scheme of military or defense activities.

Autos Pay U. S. $602,000,000 Taxes

Breakdown of the taxes collected by Uncle Sam from the motorists of the Nation during the 1941 calendar year follows:

Federal gasoline tax, $371,000,000; lubricating oil, $44,000,000; imposts on sales of new cars, trucks and motorcycles, $115,000,000; tires and tubes, $72,000,000.

If both sides makes you laugh, you are broad-minded.

Vacation Travel by Civilians Urged for Health and Morale

Secretary of the Interior Harold L. Ickes has recommended that civilian travel for purposes of relaxation should be continued as far as consistent with troop and materiel movements, as an aid in the promotion of National health and morale. Pointing out that national park areas would be continued in operation as recreational areas for visitors, the Secretary said that reports submitted by W. Bruce Macnamee, Chief of the United States Travel Bureau of the National Park Service, emphasized that America should profit by the experience of warring nations who "learned early in the war that too long hours at high pressure work resulted in decreased production."

England and the Dominion of Canada have recognized the necessity of civilian relaxation, the report emphasizes in a review of the travel situation in those countries.

"Two years of war have brought bombs, death and destruction, but have not done away with that cherished institution, the British week-end," Mr. Macnamee said. "Despite the stress of conditions, people take their Friday-to-Monday holiday, arguing that long hours of work in the city entitle them to relief."

Canada has found, he continued, that paid vacations are in complete accord with the war effort she has sustained for nearly two and a half years.

Transportation Has Big Job

The National Highway Users Conference, in a recent statement sent to Director Donald Nelson of the War Production Board, gives the following pertinent examples of American dependence upon highway transportation: (1) Use of the passenger automobile by workers in defense industries in getting to and from their jobs; (2) 2,320 cities and towns with a combined population of 12½ million without any form of local public transportation; (3) 48,000 communities in the Nation completely dependent upon highway transportation; (4) 32,400 rural letter carriers; (5) Additional movement of freight by highway to and from defense plants, and (6) Increased movement of millions of tons of farm products by highway resulting from the increased wartime agriculture production program.—*Contractors and Engineers Monthly.*

Broken Traffic Stripe Adopted to Save State $91,000 Yearly

IN the interest of war time economy, Director of Public Works Frank W. Clark has instructed the Division of Highways to substitute a broken three-inch painted traffic stripe for the four-inch solid stripe now in use on the State Highway System.

By breaking the continuous traffic stripe, it is estimated that approximately from 70,000 to 80,000 gallons of paint will be saved annually. The breaks will not exceed 25 feet in length. It is proposed further to use a broken double stripe.

The change will be made legal by an amendment to "Regulation Adopting Distinctive Marking for State Highways Indicating No Driving to the Left Thereof" which Director Clark approved.

"The Department of Public Works realizes that the broken stripe will result in a slight reduction in the efficiency of our striping methods and reduce the conspicuous feature of the continuous traffic lines now in use," Mr. Clark said. "However, I feel that in the interest of war time economy, the change is fully justified. I solicit the fullest cooperation of the motoring public in giving the same strict observance to the broken stripe as it now gives to the continuous stripe."

Mr. Clark said the paint used in striping costs $1.30 a gallon and that the minimum use of 70,000 gallons a year would mean a saving to the State of $91,000.

The greater the difficulty, the greater the glory.

State and County Provide Funds for Relocation of Highway in San Diego

BY authorizing the City of San Diego to expend funds accruing to it from the ¼-cent gas tax for development of streets of major importance and by approving an allocation of $175,000 of State highway moneys, Director of Public Works Frank W. Clark has cleared the way for completion of San Diego's San Vicente dam and reservoir project.

Involved in the undertaking is the relocation of State Route 198 a section of which will be inundated by the reservoir. Division of costs of this realignment presented a sizeable financial problem to the State, the city and the county of San Diego.

Coincident with approval of highway fund allocations, Clark awarded to Clyde W. Wood of Los Angeles a contract in the sum of $655,784.70 for grading and surfacing 11.7 miles of the new realignment highway between Lakeside Bridge and Mount Woodson.

The financing of the project, under terms of agreements with the City of San Diego and the County of San Diego, based upon a decision by the California Highway Commission and approved by Clark as to the portion of the cost of the improvement properly chargeable to highway funds is as follows:

$75,000 State Highway Fund, 93d-94th Fiscal Years

$100,000 State Highway Fund, vote of Highway Commission

$100,000 Contribution by San Diego County

$153.243.90 City of San Diego—¼-cent major street funds

$315,000 Bond Funds, contribution City of San Diego

The total work order allotment is $742,243.90, including items of contingencies, supplemental work and construction engineering.

A budget recommending the expenditure of $42,550.15 of ¼-cent gas tax funds for the 1943 fiscal year for improvement of Highway 198 at San Vicente Dam, and a supplemental budget recommending the expenditure of $178,565.23 for the acquisition of right of way and for improvement of streets of major importance and of Highway 198, both submitted by the City of San Diego, were approved by Clark. The latter work will be performed jointly by the Department of Public Works and the City of San Diego.

"I have given my approval to the allocation of State highway funds to further completion of the San Vicente dam and reservoir because San Diego is urgently in need of increased water supplies due to the tremendous increase in defense activities in that area," Clark said. "The project is desired by the Army and the Navy."

Gasoline Tax Revenues Show Downward Trend

Distribution of gasoline throughout California continued to show a gain during February, but an indication of the beginning of a downward trend was seen in the figures announced by the State Board of Equalization.

On the basis of the distribution of 147,604,993 gallons of gasoline, the February motor vehicle fuel tax amounted to $4,428,149.83, the report stated. This represented a gain of $113,333.45 or 2.63 per cent over the same month of the previous year.

Board officials have been expecting a drop in gasoline tax income because of the restricted use of tires says the report which pointed out that the 2.63 per cent gain for February, was well below the average gain of 10 per cent recorded during the last year and a half.

The February total also was well under the $4,993,304.50 assessed against January, 1942, sales which represented a gain of 10.08 per cent over January, 1941.

Sally—Oh, my brother writes me that he is a haberdasher for a railroad.

Mamie—What do you mean—"haberdasher" for a railroad?

Sally—Well, he says he has charge of the ties.

Office Boy—Could I have tomorrow afternoon off, please?

Employer—Ah yes. Your grandmother, I suppose?

Office Boy—Yes, sir. She's making her first parachute jump, you know.

"Drive For Victory" Campaign Started Among Motorists

GEARED to prevent the breakdown of California's transportation facilities, a Statewide, five-point "Drive For Victory" motor vehicle conservation program is being launched. More than 300 civic, business and fraternal organizations, including the California State Chamber of Commerce, the California Newspaper Publishers Association, and the California State Automobile Association are sharing the leadership with the Automobile Club of Southern California in carrying the conservation program to every motorist in the State.

The California motorist, as his important contribution to the all-out car saving campaign on the home front, will be asked:

1. To drive voluntarily under 40 miles an hour as requested by President Roosevelt.
2. To set up a strict personal mileage budget, curtailing all unnecessary driving.
3. To share business driving with friends, neighbors or fellow employees on a turn-about basis.
4. To have his automobile and tires thoroughly inspected regularly by competent mechanics to assure maximum life.
5. To cooperate in the wartime program of staggered business hours to relieve over-loads on available mass transportation facilities.

"This is not alone a problem of the motorist," declared S. L. Mitchell, general manager of the Automobile Club of Southern California. It vitally affects the lives, the work and the home of every Californian.

"Out of the total of 5,248 California communities, 2,240 are served entirely by the motor vehicle. In Los Angeles only 85 square miles of 1,235 square miles are served by rail. Our mass transportation systems are inadequate. Their operators admit that they can not begin to handle the transportation load if any considerable number of private automobiles are taken out of service. The regular street car and bus commuter will feel the pinch of passenger car curtailment.

Our characters are the result of our conduct.

In Memoriam

George W. Hawley

To HIS numerous friends throughout the State the sudden passing of George W. Hawley, Deputy State Engineer in charge of supervision of dams, came as a shock. Although he had been afflicted with a heart ailment for several years, only a few of his closest associates were aware of the fact, for George went smilingly on with his duties as though he were in the best of health.

After working through the day as usual on March 16th he decided to go out to the Sutter Hospital that evening for what he told friends was just a checkup. The following evening, less than 24 hours later, he had a sudden heart attack and passed away at the hospital.

Mr. Hawley was born in Portland, Oregon, November 19, 1889, the son of James and Margaret Hawley. He attended the elementary and high schools in Portland, and in 1909 entered Stanford University. In 1913 he received a Bachelor of Science Degree in civil engineering and in 1916 the Degree of Engineer.

GEORGE W. HAWLEY

Following his graduation in 1913 he went to work for the Oregon Electric Company but left that company in 1914 to become construction engineer for the South San Joaquin Irrigation District. He remained with the irrigation district until 1917 during which time he was in charge of construction of Woodward Dam. From 1917 until 1928 he was employed by East Bay Water Company during construction of the San Pablo Dam and the San Leandro Dam. He rose to the position of Chief Construction Engineer with the company and when it was sold to the East Bay Municipal Utility District he became assistant director of operations for that organization. Then from 1925 until he entered the State service in 1929 he also maintained a private practice as consulting engineer on hydraulic projects. Following the St. Francis Dam disaster, the Legislature in 1929 placed the supervision of dams in California under the State Engineer in the Division of Water Resources, Department of Public Works, and Mr. Hawley came into State service in charge of dams.

As Deputy State Engineer in charge of dams Hawley traveled to all parts of the State and was widely known in engineering and utility circles. He was a member of the Sigma Xi, honorary engineering society, the American Society of Civil Engineers, the American Water Works Association, the American Concrete Institute and the Sutter Club in Sacramento.

A requiem mass was celebrated in Sacramento on Thursday, March 19th, in the Cathedral of the Blessed Sacrament and the burial took place in the city of Portland, Oregon. Surviving are his wife, Sara Nancy Hawley of Sacramento; a brother, Henry James Hawley of Berkeley, and a sister, Mary E. Hawley of Tracy.

BUILDING SUMMARY

The automotive industry in the last 44 years has built in the United States alone 86,168,702 cars, trucks and buses with a wholesale value of $58,207,700,000. During this period there have been 1,481 different makes of cars built.

VICTORY CAR CLUB

With 1,000 cars in the "pool," a "Victory Car Club" has been organized on a community basis in a defense industry plant near Chicago whereby members "take turns" transporting fellow-workers to their jobs. Informal transportation clubs have been formed in many localities in the Mid-West.

TAXES ADD TO GAS COST

Taxes add 44 per cent to the annual cost of gasoline in the United States, according to studies conducted by the Automobile Club of Southern California.

Fire is the test of gold; adversity of strong men.

Highway Bids and Awards for the Month of March, 1942

MARIN COUNTY—Intersection of Routes 1 and 52 at Alto, about 0.4 mile in length, roadway intersection to be widened and surfaced with crusher run base and plant-mixed surfacing, and provided with channelization and traffic signal facilities. District IV, Route 1, Section C. A. G. Raisch, San Francisco, $22,938; E. A. Forde, San Anselmo, $26,099; Lee J. Immel, Berkeley, $31,764. Contract awarded to J. J. Ongaro, San Anselmo, $19,636.

MARIN, NAPA AND SONOMA COUNTIES—Oiling roadside vegetation on 173 roadside miles at various locations in District IV. Sheldon Oil Co., Suisun, $5,980; J. J. Ongaro, San Anselmo, $6,302. Contract awarded to Pacific Truck Service, Inc., San Jose, $5,681.

MERCED AND MARIPOSA COUNTIES—Oiling roadside vegetation on 116 roadside miles at various locations in District X. Close Building Supply, Hayward, $2,560; Pacific Truck Service, Inc., San Jose, $2,716. Contract awarded to Sheldon Oil Co., Suisun, $2,619.

MONTEREY COUNTY—Across Salinas River, about 3 miles south of Castroville at Neponset, a bridge to be constructed. District V, Route 56, Section I. A. Soda & Son, Oakland, $379,904; Earl W. Heple, San Jose, $422,289. Contract awarded to Harry J. Oser and Peter Sorenson, Redwood City, $329,950.

MONTEREY COUNTY—Between Castroville and Route 2, near Prunedale, about 5.2 miles to be graded and surfaced with crusher run base and plant-mixed surfacing. District V, Route 22, Section A. J. E. Haddock, Ltd., Pasadena, $532,224. Contract awarded to Harms Bros., Sacramento, $478,028.

MONTEREY COUNTY—Between Hames Valley School and East Reservation Boundary, about 13.4 miles to be graded and surfaced with plant mixed surfacing on cement treated base. District V, Jolon-Bradley. Marshall S. Hanrahan, Redwood City, $1,047,930. Contract awarded to N. M. Ball Sons, Berkeley, $696,992.

MONTEREY COUNTY—Between Route 2 near Bradley and Hames Valley School, about 5.9 miles to be graded and surfaced with plant mixed surfacing on cement treated base. District V, Bradley. J. E. Haddock, Ltd., Pasadena, $425,263. Contract awarded to Louis Biasotti & Son, Stockton, $371,584.

MONTEREY COUNTY—Between North Reservation Boundary and Quinado Canyon, about 3.9 miles to be graded and surfaced with cement treated base and plant-mixed surfacing. District V, Jolon KingCity. N. M. Ball Sons, Berkeley, $279,221. Contract awarded to Brown, Doko & Baun, Pismo Beach, $260,721.

MONTEREY COUNTY—A reinforced concrete slab bridge across Tembladero Slough at Castroville. District V, Route 56, Section I. Earl W. Heple, San Jose, $20,725; John Carcano, San Rafael, $22,248; Granite Construction Co., Watsonville, $22,830; Bert P. Ward & Son, San Jose, $23,235; Harry J. Oser & Peter Sorensen, Redwood City, $29,975. Contract awarded to Dan Caputo, San Jose, $17,790.

PLUMAS COUNTY—Between Keddie and Quincy, about 7.0 miles to be plant-mix surfaced. District II, Route 21, Sections C,D. Harms Bros., Sacramento, $27,668. Contract awarded to Poulos & McEwen, Sacramento, $26,770.

RIVERSIDE COUNTY—Between 3 miles south of March Field and Dracaea Avenue, about 5.0 miles in length to be graded and surfaced with plant-mixed surfacing on cement treated base. District VIII, Route 78, Section D. Oswald Bros., Los Angeles, $401,687; Griffith Co., Los Angeles, $455,731; Fredericksen & Westbrook, Sacramento, $470,434; J. E. Haddock, Ltd., Pasadena, $521,254; W. E. Hall Co., Alhambra, $597,928. Contract awarded to George Herz & Co., San Bernardino, $393,513.

RIVERSIDE COUNTY—Between Dracaea Avenue and Route 19, about 1.5 miles to be graded and surfaced with plant-mixed surfacing on cement treated base and reinforced concrete overhead crossing to be widened and grade separation structure to be constructed. District VIII, Routes 19 & 78, Sections C, D. J. E. Haddock, Ltd., Pasadena, $189,433; Oberg Bros., Los Angeles, $192,193. Contract awarded to George Herz and Co., San Bernardino, $169,851.

RIVERSIDE COUNTY—Between Riverside and Route 78, about 3.8 miles to be graded and paved with portland cement concrete pavement. District VIII, Route 19, Sections B,C. Matich Bros. & E. L. Yeager, Riverside, $476,475; Oswald Bros., Los Angeles, $512,256; United Concrete Pipe Corp., Los Angeles, $594,572. Contract awarded to J. E. Haddock, Ltd., Pasadena, $461,997.

SAN DIEGO COUNTY—On Pacific Highway between Enterprise Street and Mission Bay, about 2 miles in length, to be graded, existing pavement to be widened with portland cement concrete base and asphalt concrete pavement to be placed on existing pavement and new portland cement concrete base. District XI, Route 2, San Diego. R. E. Hazard & Sons, San Diego, $215,354; V. R. Dennis Construction Co., San Diego, $221,712; Daley Corporation, San Diego, $225,314. Contract awarded to Griffith Co., Los Angeles, $124,982.

SAN DIEGO COUNTY—Between Route 77 and 0.6 mile westerly, about 0.6 mile to be graded and surfaced with plant-mixed surfacing. District XI, Route Fallbrook. J. E. Haddock, Ltd., Pasadena, $36,710; R. L. Oakley, Pasadena, $39,937; Walter H. Barber, San Diego, $46,666. Contract awarded to Arthur A. Johnson, Los Angeles, $29,935.

SAN DIEGO COUNTY—On Pacific Highway between Market Street and Coutts Street about 2.8 miles to be graded and paved with asphalt concrete and portland cement. District XI, Route 2, Section S.D. Griffith Co., Los Angeles, $364,712; Daley Corp., San Diego, $372,694. Contract awarded to V. R. Dennis Construction Co., San Diego, $347,975.

SAN DIEGO COUNTY—At Camp Callan Highway Crossing about 14 miles north of San Diego, a reinforced concrete underpass to be constructed, and approaches about 0.5 mile in length to be graded and surfaced with plant-mixed surfacing. District XI, Route 2, Section S.D. F. Fredenburg, South San Francisco, $80,803; J. E. Haddock, Ltd., Pasadena, $83,927; V. R. Dennis Construction Co., San Diego, $85,188. Contract awarded to B. G. Carroll & Harry L. Foster, San Diego, $78,907.

SAN DIEGO COUNTY—A reinforced concrete bridge to be constructed over Canyada Way, on Robinson Ave., between Eighth Ave. and Tenth Avenue, and about 0.12 mile of approach roadway to be graded and paved with portland cement concrete pavement. District XI, Robinson Avenue. V. R. Dennis Construction Co., San Diego, $58,904; R. E. Hazard & Sons, San Diego, $59,483; J. E. Haddock, Ltd., Pasadena, $61,502; Oberg Bros., Los Angeles, $67,659; Contracting Engineers Co., Los Angeles, $70,486; B. G. Carroll & H. L. Foster, San Diego, $75,168. Contract awarded to F. Fredenburg, So. San Francisco, $58,648.

SAN DIEGO COUNTY—Two highway grade Separations on Pacific Highway in the city of San Diego, one at Witherby St. and the other at Barnett Avenue, to be constructed. District XI, Route 2, Section San Diego. R. E. Hazard & Sons, San Diego, $834,314. Contract awarded to J. E. Haddock, Ltd., Pasadena, $761,938.

SAN DIEGO COUNTY—Between Lakeside Bridge and Mount Woodson, about 11.7 miles to be graded and bituminous surface treatment applied. District XI, Route 198, Section H. M. S. Ross and R. E. Hazard & Sons, San Diego, $784,313; Macco Construction Co., Clearwater, $796,552; W. E. Hall Co., Alhambra, $820,427. Contract awarded to Clyde W. Wood, Los Angeles, $655,784.

SOLANO COUNTY—Between 1.2 miles north of Rio Vista and Ryer Island Ferry, washed out portions to be filled and surfaced with untreated rock surfacing. District X, Route 99, Section A. C. C. Steele, Rio Vista, $18,137; Sheldon Oil Co., Suisun, $18,115; C. E. Huls, Merced, $17,312; L. G. Lentz, Sacramento $18,035; Oranges Bros. Const. Dept., Stockton, $15,800. Contract awarded to Claude C. Wood, Lodi, $15,050.

SOLANO COUNTY—Between Benecia and 3.2 miles north, about 3.9 miles to be graded and surfaced with plant-mixed surfacing on crusher run base and a reinforced concrete bridge to be constructed. District X, Route 74, Section Ben.,C. Union Paving Co., San Francisco, $309,154; Eaton & Smith, San Francisco, $325,026; Louis Biasotti & Son, Stockton, $325,501; Harms Bros., Sacramento, $338,681; C. L. Harney, San Francisco, $365,517; Fredericksen & Westbrook, Sacramento, $376,099; Contract awarded to Parish Bros., Sacramento, $288,421.

SOLANO, SAN JOAQUIN, CALAVERAS AND AMADOR COUNTIES—Oiling 123 miles of roadside vegetation at various locations in District X. Close Building Supply, Hayward, $2,976; Pacific Truck Service, Inc., San Jose, $3,034. Contract awarded to Sheldon Oil Co., Suisun, $2,851.

STANISLAUS, TUOLUMNE, CALAVERAS AND AMADOR COUNTIES—Oiling roadside vegetation on 141 roadside miles at various locations in District X. Close Building Supply, Hayward, $3,122; Pacific Truck Service, Inc., San Jose, $3,203; Hayward Building Material Co., Hayward, $3,029. Contract awarded to Sheldon Oil Co., Suisun, $3,087.

The new traffic cop had been told by his inspector to overtake and stop a speeding car. Ten minutes later he rang up to report: "Car was being driven by an actress. I stops her, pulls out my notebook. She snatches it, writes her autograph and leaves me standing."

Pedestrian: A man who has two cars, a wife, and an 18-year-old daughter.

State of California
CULBERT L. OLSON, Governor

Department of Public Works
Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

FRANK W. CLARK, Director of Public Works

FRANZ R. SACHSE, Assistant Director

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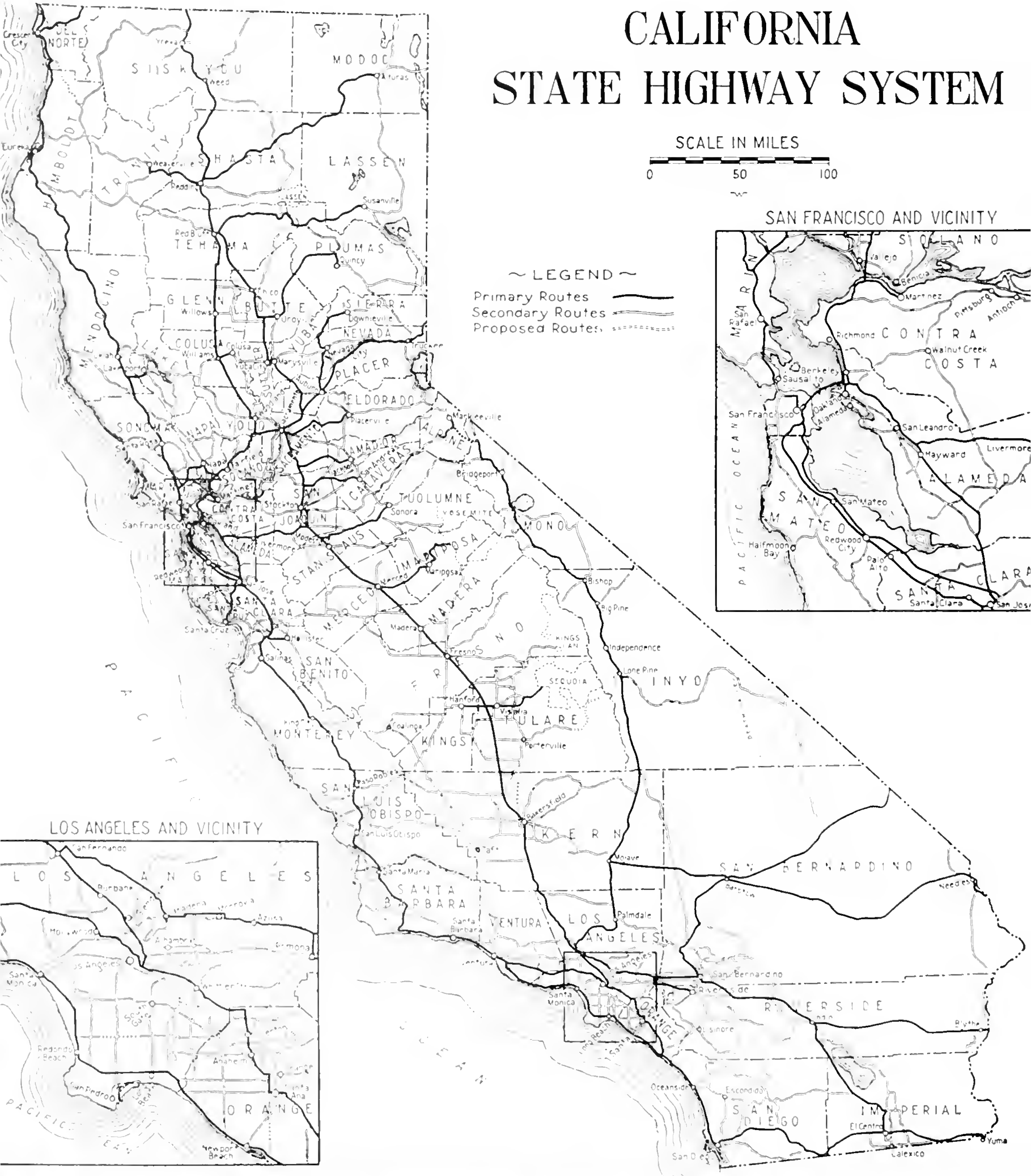

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Official Journal of the Division of Highways, Department of Public Works, State of California

FRANK W. CLARK, Director C. H. PURCELL, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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Divisions of Department of Public Works Swing Into Full Stride on War Defense Efforts

Following is a summary of a report made to Governor Culbert L. Olson by Director of Public Works Frank W. Clark pursuant to a request from the Governor made to heads of all State departments. Director Clark's report covered defense activities of the Divisions of Highways, Water Resources and Architecture of the Department of Public Works.

IN January I announced that war defense work would subordinate normal activities of all divisions of the State Department of Public Works during 1942.

I am pleased to report that the defense contributions since that time by the Division of Highways, the Division of Architecture and the Division of Water Resources have far exceeded my anticipations.

During the past three months, at the request of Governor Culbert L. Olson, the department has prepared a number of confidential reports for the military authorities for which it has been highly commended.

The Division of Highways has made surveys on the amount and location of publicly owned dirt-moving and construction equipment in the metropolitan centers of the State; on the suitability of various highway routes in southern California for evacuation purposes with particular reference to water supplies and housing facilities; and on strategic bridges.

Pursuant to a request to Governor Olson from the War Production Board, the Division of Highways has also completed a survey of scrap metal and equipment now stored in various highway district maintenance storage places and in shops. A total of 191 tons of such material already has been reported to the War Production Board.

In the shops of the Division of Highways there was produced a blackout adapter for lamps and lanterns used at night on highways by construction and maintenance crews. This invention has been made available to the State Council of Defense and through that agency may be obtained by cities and counties for use on county roads and municipal streets.

The Maintenance Department of the Division of Highways is entrusted with maintaining armed guards on powder magazines, maintenance yards and other important storage locations. A 24-hour guard is maintained.

In addition the Maintenance Department through arrangements with the Pacific Telephone and Telegraph Company maintains a direct connection with 21 swing drawbridges operating on 21 navigable streams in Sacramento, San Joaquin, Napa and Sonoma counties and from a special telephone communications office can notify all bridge tenders almost instantly of orders for a blackout.

Surplus equipment which has accumulated during the past decade in California's 2,000 State-owned buildings, including State schools, colleges, hospitals and other institutions is being catalogued and pooled to meet war shortages of critical material.

A survey of State property undertaken by State Architect Anson Boyd at the request of Governor Olson as Chairman of the Council of Defense, already shows that well over $100,000 worth of useable discarded equipment will be available for exchange among State agencies and institutions to aid in maintaining these indispensable services and thereby eliminating to a great extent the use of critically needed war supplies.

The State's properties are being conditioned by the various departments involved in cooperation with the Division of Architecture to withstand the months or years when metal and other critical materials will go into guns, planes, munitions and other war necessities instead of normal peacetime repair parts.

For purposes of keeping purchases of surplus stock necessary for the duration to a minimum, the Division of Architecture is obtaining detailed information relative to the type, kind, make, age, and condition of surplus parts now in storage in various places to the end that these parts and stocks

(Continued on page 4)

GOVERNOR ASKS CARE IN PREVENTING TIRE DAMAGE ON ROADS

Several thousand employees of the Division of Highways in the eleven highway districts throughout California will cooperate in a campaign to protect motorists from tire damage on State roads.

In accordance with a request from Governor Olson, Director of Public Works Frank W. Clark has requested all personnel of the Division of Highways, particularly the maintenance crews, to be especially vigilant in removing from highways and highway shoulders any objects such as nails, glass, bottles, metal wire, etc., which might cause injury to tires.

Mr. William A. Lippman of Palm Springs started a one-man campaign to gather metal scraps and broken glass he found on highways in Riverside County. In one trip over U. S. Route 60 between Beaumont and Riverside, Mr. Lippman gathered quite a collection of such tire hazards and reported his findings to the Commandant at March Field and to Governor Olson. Clark thereupon issued instructions to the Division of Highways and wrote the following letter to Mr. Lippman:

"Governor Olson has referred to me your very interesting letter of April 3, 1942.

"The Governor has expressed a great interest in your suggestion and today wrote me asking me to reply to you direct and requesting me to instruct our highway maintenance crews throughout the State to be as vigilant as possible in seeking for and removing any obstacles on the highways or highway shoulders that might be injurious to tires. * * *

"I am today issuing appropriate instructions to our highway maintenance organizations throughout the State and am also instructing the editor of our California Highways and Public Works magazine to run a suitable story on the subject in his next issue. In this manner, I think your proposal will be called directly to the attention of thousands of individuals and organizations in California who will be in a position to cooperate in this worthwhile aim.

"May I thank you for calling the matter to our attention."

Army Engineers Study California Soil and Foundation Test Methods in Runway Design

By O. J. PORTER, Senior Physical Testing Engineer

REPRESENTATIVES of the United States Army Engineer Offices throughout the United States attended a lecture course and conference on the California method of determining the relative bearing value of soils and its application to design of highways and runways. The conference was held April 6th to 10th at the Sacramento District Office of the U. S. Engineering Department and the Materials and Research Department of the State Division of Highways.

Army engineers inspect runway test pavement at Stockton field. Electric recording equipment for measuring subgrade pressure and pavement deflection under heavy wheel loads is mounted in station wagon at left

The various meetings were planned by the office of the Chief of Army Engineers at a conference attended by the writer in Washington, D. C., during the month of February.

Among the U. S. Engineers attending the lectures were the following: T. A. Middlebrooks, Principal Engineer and head of the Soils Section, Office of the Chief of Army Engineers in Washington, D. C.; E. J. Merrick, Principal Engineer and Chief of Design of the Caribbean Division in New York City; Lt. H. A. Fidler, Officer in Charge of Foundation Investigations, North Atlantic Division, Ithaca, N. Y.; W. I. Kennerson, Senior Engineer, and Assistant Chief, War Construction Section, South Atlantic Division, Atlanta, Ga.; R. Philippe, Senior Engineer in Charge of Divisional Soils Section, Ohio River Division, Cincinnati, O.; S. M. Gleaser, Engineer and Head of Specifications Section, Upper Mississippi Valley Division, St. Louis, Mo.; F. F. Smalla, Associate Engineer and Head of Airport Section, Great Lakes Division in Cleveland, O.; F. B. Slichter, Principal Engineer and Chief of Design Section, Missouri River Division, Kansas City, Mo.; R. M. German, Assistant Engineer, Lower Mississippi Valley, Vicksburg, Miss.; Ralph Hansen, Division Soils Engineer, Dallas, Tex.; H. E. Brown, Engineer in Charge of Research Section of North Pacific Division, Portland, Ore.; W. L. Davis, Associate Engineer and head of U. S. District Laboratory, Sacramento; M. C. Collins, Senior Engineer and Assistant Head Engineer and S. M. Cotten, Associate Engineer, South Pacific Division, San Francisco; W. H. Jervis, Engineer and head of the Soils Section, Vicksburg, Miss.

PROGRAM OF MEETINGS

Following is the program, together with a digest of the proceedings of the conference:

On April 6, 1942, a morning meeting was held at the U. S. district office at which introductory remarks covering the purpose and scope of the lecture course were scheduled by Col. R. C. Hunter, U. S. District Engineer; C. H. Purcell, State Highway Engineer; T. A. Middlebrooks, U. S. Principal Engineer; T. E. Stanton, Materials and Research Engineer, State Division of Highways."

Speaking for Col. Hunter, who was called away from Sacramento, G. E. Goodall, U. S. Principal Engineer, welcomed the visiting engineers to Sacramento and related the facts of the Sacramento district's successful application of California's test methods to runway design during the past year.

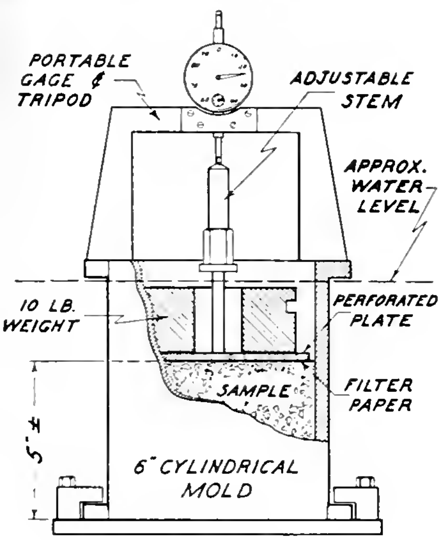
Because of urgent defense work on access highways in the southern section of the State, Highway Engineer Purcell was unable to attend and Mr. Stanton, on behalf of Mr. Purcell, offered the full cooperation of the Division of Highways.

Mr. Stanton invited the engineers to visit the State Materials and Research Department. He also reviewed the development in 1929 of California's test procedure for determining the compacted density and optimum moisture content of soils and cited the need for thorough consolidation to obtain maximum stability of subgrade on highways and airport work.

Followed an introduction and detailed outline of the lecture course by the writer.

This talk was illustrated with slides showing various types of subgrade failures on highways and airports. A comparison was made between highway and runway service requirements, including intensity and repetition of loads, influence of dynamic reactions of trucks and planes, and the effect of these factors on pavement and subgrade design.

Determining deflection of pavement under loads corresponding in footprint and contact pressure to those of heavy bombers. Electric eye equipment in boxes in foreground



Expansion test for determining swell of bearing value specimens

An announcement of subsequent meetings and field trips was made by Wilson L. Davis, Associate Engineer, Chief, U. S. E. D. Laboratory, Sacramento.

The afternoon meeting was held at the Materials and Research Laboratory of the California Division of Highways at which a demonstration of test procedure was given by the writer that included: (a) Preparation of samples; (b) compaction test; (c) optimum moisture test; (d) bearing and expansion tests.

The next day morning and afternoon meetings were held at the State Materials and Research Laboratory at which performances of test procedures were made by engineers attending the course and in the evening a lecture was given by the writer at the U. S. district office on (a) compaction

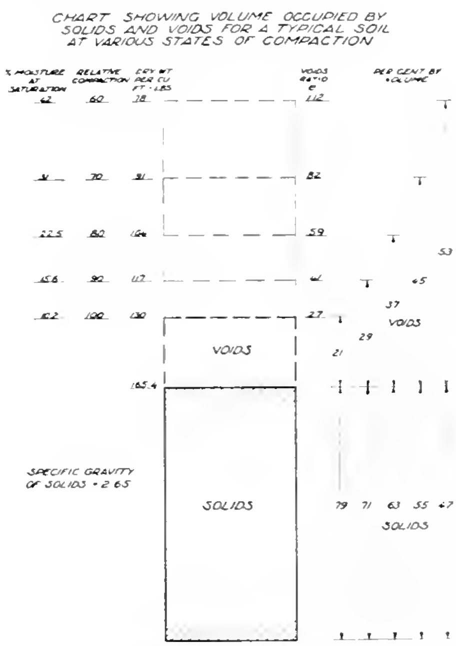
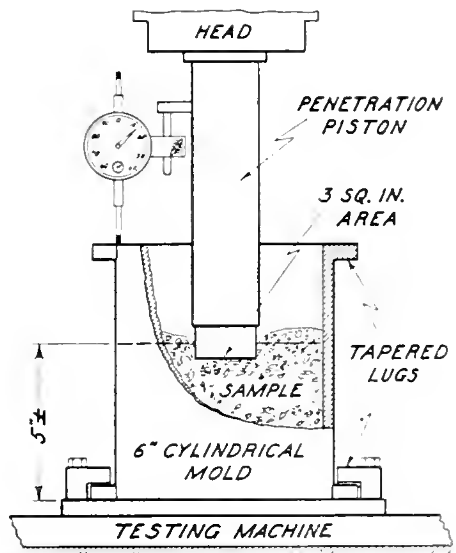


Chart showing volumes of solids and voids for various states of compaction

tests; (b) bearing tests; (c) expansion tests, which was followed by a discussion with Mr. Middlebrooks as chairman.



Bearing test equipment for determining resistance of base and subgrade material

The reasons for the development of the tests were discussed and it was pointed out that the detailed procedure was only adopted after establishing an empirical relationship between the test values and the performance of subgrade and base materials in actual service.

In this study of field conditions good compaction and high density were found necessary to avoid settlement and failure of the roadway under traffic. Blanket courses of pit run gravel or layers of selected subgrade material of high bearing value were also found to be both desirable and economical for constructing a satisfactory foundation for highways.

A morning meeting was held on April 8th at the U. S. E. D. Sacramento District Laboratory at which a demonstration of sampling methods and test procedure was given by U. S. Associate Engineer, W. L. Davis, showing quick methods for obtaining undisturbed samples for determining the bearing value of subgrade material in its natural condition of density. The exploration of soil deposits by hand-boring methods, including soil augers and the California type soil sampler were also demonstrated.

ILLUSTRATED WITH SLIDES

At the afternoon meeting the following subjects were covered: (a) Exploration, Soil Sampling Conditions, and Procedure by Mr. Davis; (b) Deep Borings in Unstable Airport Areas by Mr. Ferron, Assistant Physical Testing Engineer, State Division of Highways; (c) Preparation of Soil Profiles by Mr. Porter; (d) Discussion, Mr. Middlebrooks, Chairman.

The lectures were illustrated with slides showing sampling tools and typical application of boring methods and included a free discussion of difficulties encountered in securing correct information regarding the density, moisture content and the in-place characteristics of foundation materials.

Soil profiles showing condensed, but complete foundation data for various bridges, buildings and highway projects throughout California were also illustrated.

VISIT FLYING FIELD

A field inspection trip to Stockton flying field occupied the morning of April 9th that included: (a) Inspection of runway test section on unstable soil; (b) demonstration of electrical equipment for measurement of pavement deflection and subgrade pressure by J. E. Barton, Associate Physical Testing Engineer, State Division of Highways.

During this trip the engineers were able to observe the action of heavy wheel loads on the runway test section and to formulate an independent opinion regarding the thickness of foundation required over the unstable adobe soil present at this field.

Much interest was shown in the electrical equipment previously developed by the California Division of Highways in cooperation with the General Electric Co. for measuring the pavement deflection and subgrade pressure under moving loads and particularly the results obtained on the test section with a heavy bomber which showed the influence of the dynamic reactions for warm-up and take-off motor speeds.

UNSTABLE CONDITIONS SHOWN

A trip to Sacramento Air Depot in the afternoon permitted an inspection of unstable foundation conditions on a county road to the field and a runway at the field.

At the evening meeting in the district office, the writer lectured on "Soil Conditions and Design of Flexible Pavements."

The tests recently made for the Army Engineers on the Stockton Runway Test Section with wheel loads duplicating the footprint and contact pressure of heavy bombers were presented, together with a tentative criteria for the design of foundations for flexible pavements. The necessity of drainage and the proper use of thick layers of imported fill material and substantial base courses to carry heavy bombers over weak soils was clearly developed during this session.

FOUNDATION DISCUSSION

The discussion which followed with Mr. Middlebrooks as Chairman centered around the selection and economic use of local subgrade materials for constructing an adequate foundation for the pavement.

Questions and round-table discussions occupied the final meeting at the district office on April 10th, with closing remarks by Mr. Middlebrooks.

This session was the most interesting of the conference as all of the engineers attending had previously had many years' experience on soils and foundation work in connection with the Army's extensive construction program including the construction of airports, levees, dams and other river and harbor control works. Because of their broad experience and familiarity with modern foundation practice it was possible to cover the subject in sufficient detail during the week allotted for the conference.

Public Works Activity in Defense Efforts

(Continued from page 1)

may be exchanged through the offices of the division.

In order that this procedure be operable, it is proposed that these exchanges be made on a "loan" or "in kind" basis. It is probable a very substantial sum will be represented by equipment which may be so interchanged to the mutual benefit of all agencies involved.

The Division of Architecture is completing a survey of all public schools in California to determine to what extent they offer protection against bombing raids and incendiary explosives.

The Division of Water Resources made an exhaustive report on dams and water supplies throughout the State.

In accordance with instructions issued by Governor Olson to all State departments this division has also completed a check of every motor vehicle in its control, including the mileage to be expected from the rubber now on the car, mileage in the vehicle itself, what repairs could be made in order to prolong its life and to what its use could be restricted. Similar reports will be made by other divisions.

The Division of Highways has completed surveys and plans and specifications for $25,000,000 worth of defense highways. The total of access roads requested by the Federal Government of California is in excess of $45,000,000.

In spite of the fact that more than 200 engineers and employees of the Division of Highways have gone into service with the armed forces or have accepted other employment created by the National Defense Program, the division has been able to complete or place under construction more than $7,344,535 worth of military roads.

Normal highway construction has had to give way to work urgently required by the Army and the Navy. Indicative of the extent to which the Division of Highways is devoting its time and engineering talent to defense is the fact that projects advertised for bid opening during April totaled $2,473,700, of which $1,634,500 were for military access road projects and $420,000 for improvement to the strategic highway network.

64 Highway Construction Contracts Under Way April 1; 34 for Bridge Structures

IN a report to Governor Olson covering the work of the Division of Highways for the month of March, 1942, Director Frank W. Clark states that the extent of State highway construction under way at the present time may be gauged by the 98 contracts in force with the Department on the first of April. Of these contracts, 64 are for road construction and 34 for the construction of bridges and grade separations.

The value of State highway contracts awarded during the month of March totaled $4,156,700. Of this amount $3,284,200 were for construction and improvement to roads serving as access to military establishments and financed from Federal funds authorized for such construction by the Defense Highway Act of 1941.

Projects advertised in March for bid opening during April totaled $2,473,700, of which $1,634,500 were for Access Road projects and $420,000 for improvement to the Strategic Highway Network.

Activities of the Division of Highways during March are indicated by the total amount of $9,306,500 in work orders written for construction and maintenance and for the projects advertised for bid opening in April. Segregation of this total to the various phases of the work is shown in the following tabulation.

CONSTRUCTION		
Construction and Maintenance Contracts	$4,156,700	
Day Labor Construction	654,200	
Day Labor Minor Improvements	300	
Day Labor Access Road Construction	248,900	
Day Labor Flight Strip Construction	20,000	
Engineering	209,600	
Right of Way	26,000	
Right of Way for Route 2 in Los Angeles	306,300	
Subtotal		$5,622,000
ADVERTISED FOR BID OPENING IN APRIL		2,473,700
MAINTENANCE		
General Maintenance	$426,600	
Replacements	577,500	
Slide Removal	151,000	
Buildings and Plants	800	
San Francisco-Oakland Bay Bridge (Operation, Maintenance and Insurance)	54,900	
Subtotal		$1,210,800
Total		$9,306,500

The following summary gives the type, mileage and estimated costs for contract work put under way during March.

Type	Miles	Amount
Grade and pave	3.8	$509,000
Grade and plant-mixed surface	12.2	547,200
Grade and plant-mixed surface on cement treated base	22.9	1,422,200
Grade and bituminous surface treatment	11.7	742,200
Grading only	3.2	337,200
Bridges and grade separations	(5)	559,700
Oiling roadside vegetation	553.0	17,200
Miscellaneous contracts	----	22,000
Total		$4,156,700

A similar tabulation for projects advertised for bid opening during the month of April is given below.

Type	Miles	Amount
Grade and pave	20.0	$1,176,400
Grade and plant-mixed surfacing	10.6	235,000
Grade and plant-mixed surfacing on cement treated base	14.0	798,000
Armor coat	12.0	91,300
Bridges	(4)	173,000
Total		$2,473,700

Mass Highway Traffic Must Be Safeguarded

H. S. Fairbank of the Public Roads Administration of the Federal Works Agency in an address delivered before the American Society of Civil Engineers, in Roanoke, Va., recently said:

"Automatic counters throughout the country show that February, 1942, traffic on rural highways was 7.6 per cent less than that of the same month a year earlier, and January travel was only 1.1 per cent greater than that of January, 1941. In contrast, rural traffic increased each month of 1941 over the corresponding month of the previous year, with December, 1941, traffic 12.5 per cent greater than a year earlier."

While predicting further declines in "unessential" travel, the Public Roads official emphasized that "large elements of the total highway transport are essential in the highest degree," and that "these essential movements must be safeguarded."

He quoted from a survey of 749 Michigan corporations manufacturing war materials, showing that 70 per cent of these firms received 50 per cent, 38 per cent received 90 per cent, and 13 per cent received 100 per cent of their incoming materials by truck. Seventy-six per cent ship 50 per cent, 43 per cent ship 90 per cent, and 15 per cent ship 100 per cent of their products by truck.

Of the 434,700 workers employed at these plants, 75 per cent were reported to travel to work by automobile.

Every noble activity makes room for itself.

Bids and Awards for April

LOS ANGELES COUNTY—Santa Monica Blvd. between Croft Avenue and Fairfax Avenue, about 0.7 mile to be surfaced with asphalt concrete. District VII, Route 162, Section A. Southwest Paving Co., Roscoe, $29,282; Vido Kovacevich, South Gate, $31,242; Griffith Co., Los Angeles, $33,650. Contract awarded to Frank West, Los Angeles, $27,076.

MONTEREY COUNTY — Between 0.7 mile north of Monterey Avenue in Marina and Castroville, about 5.2 miles to be graded and paved with Class "B" Portland cement concrete. District V, Route 56, Section I. United Concrete Pipe Corp., Los Angeles, $497,709. Contract awarded to Granite Construction Co., Watsonville, $474,514.

MONTEREY COUNTY — An overhead crossing over the tracks of the Southern Pacific Co. one-half mile northeast of Castroville to be constructed. District V, Route 22, Section A. Dan Caputo, San Jose, $39,789; Trewhitt-Shields & Fisher, Fresno, $39,905; Granite Construction Co., Watsonville, $42,900; Bert P. Ward & Son, San Jose, $44,283; Harry J. Oser & Peter Sorensen, Redwood City, $46,790; Earl W. Heple, San Jose, $48,360; John Carcano, San Rafael, $49,775; F. Kaus, Stockton, $54,900; A. Soda & Son, Oakland, $71,527. Contract awarded to Kiss Crane Service, Berkeley, $37,721.

SACRAMENTO COUNTY — Between Ben Ali and McClellan Field, about 3.3 miles, to be graded and paved with Portland cement concrete. District III. N. M. Ball Sons, Berkeley, $141,981; A. Teichert & Son, Inc., Sacramento, $147,316; Frederickson & Westbrook, Sacramento, $148,315. Contract awarded to J. R. Reeves, Sacramento, $134,138.

SAN BERNARDINO COUNTY — Between Cherry Avenue and San Bernardino, about 8.6 miles to be surfaced with plant-mixed surfacing. District VIII, Route 9, Sections A, B, Ria., C, S. Bd. Vido Kovacevich, South Gate, $109,717; Griffith Co., Los Angeles, $110,419; Oswald Bros., Los Angeles, $111,725; W. P. Powell Paving Co., Los Angeles, $113,229; W. E. Hall Co., Alhambra, $114,938; P. J. Akmadzich, Sunland, $119,495; Basich Bros., Torrance, $119,520; J. E. Haddock, Ltd., Pasadena, $141,645. Contract awarded to George Herz & Co., San Bernardino, $106,719.

SAN DIEGO COUNTY — A reinforced concrete slab bridge across Las Chollas Creek in the city of San Diego to be constructed. District XI, The Contracting Engineers Co., Los Angeles, $88,312; Bent Co., Los Angeles, $88,408; V. R. Dennis Construction Co., San Diego, $94,802; R. E. Hazard & Sons, San Diego, $104,813; Carlo Bongiovanni, Los Angeles, $123,508. Contract awarded to Oberg Bros., Los Angeles, $80,102.

SOLANO COUNTY—Between 3.1 miles north of Fairfield and Ulatis Creek, about 5.3 miles, borders of crusher run base to be constructed on each side of the existing pavement and armor coat applied thereto. District X, Route 7, Section C, Vacaville. A. J. Clausen, Berkeley, 32,596; Beerman and Jones, Sonora, $36,730; Lee J. Immel, Berkeley, $36,733. Contract awarded to Sheldon Oil Co., Suisun, $28,475.

Electronic Roadside Speed Timer Developed by Division of Highways

By W. M. RIETH, District Traffic Engineer

THE Division of Highways has recently put into use an electronic timer to determine the speed of traffic on California highways. After two years of experimentation the Traffic and Safety Department of the Division has perfected an instrument which satisfies the requirements of portability, accuracy and convenience of operation.

The speed at which traffic will move over a completed project, particularly the maximum speed, is perhaps the most important factor to be considered in the design of sight distance, superelevation curvature and gradient.

Speed is an important factor also in traffic accidents. It directly influences road capacity and is to be considered in connection with all studies seeking to solve congestion problems.

There has been an absence of definite, reliable data on traffic speeds, partially due to the lack of an adequate and accurate measuring mechanism. Traffic engineers have recognized the need for this information and attempted to have a suitable instrument constructed for procuring speed data.

An ideal instrument is one which satisfies the requirements of portability, accuracy, is easily concealed, simple to operate, and records total vehicles and speeds.

Such an instrument is the two-cell, photoelectric, bidirectional, electronic timer. A built-in electric counter tallies vehicles automatically. The traffic speeds are read and recorded manually. Experiments are now under way to obtain the automatic recordation of speeds. The length of base line is seventeen and six-tenths inches. The heaviest unit weighs 55 pounds. It can be set up by one person anywhere, day or night, in less than five minutes. Most of this time is required to accurately align the eight beams upon the photo-cells. However, this has been reduced to a minimum by installing low-power, telescope rifle sights, with cross-hairs, on each unit.

The complete assembly consists of: (1) a two-beam light unit and a 6-volt storage battery; (2) a two-beam photo-cell receiver unit; and (3) an amplifier unit and meter. The photo-cells and amplifier secure their energy from the regular 6-volt car battery in the car, operated by the recorder. The two small lights in the light source draw approximately 5½ amperes. The average storage battery will operate these continuously for 16 hours or longer. The total current drain of the photo-cells, amplifier, and meter is only 3½ amperes, and the regular car battery is used.

A good car battery will stand about a 35-ampere drop without affecting the starting or the car's operation. Experience shows that if the car motor is run for approximately 15 minutes every two hours, the battery voltage will drop a very small amount in 10 hours of speed-checking. The charging of the battery by running the car motor does not interfere with the continuous operation of the photo-electric meter.

The accuracy of the meter is well within any normal requirements. Numerous checks have been made against vehicle speedometers of different brands. Speedometers previously checked by other methods and found to be reasonably accurate, were used for checking.

The accuracy of the meter is dependent upon the initial graduation of the meter scale. This was done with a synchronous motor-driven propeller with wide blades. Speed of the motor was regulated to accurately break the light beams at a known time.

During this test, it was discovered that a base line of 17.6 inches would give even 10 and hundred increments as a reciprocal of even miles per hour. For example, one-thousandth of a second time-interval between breaking of the two beams equaled 100 miles per hour.

It may seem to the average person that it would be impossible to secure accurate results with such short time-intervals, but one need only consider the fact that light and electricity travel at a speed of approximately 186,000 miles per second, to realize that the element of speed does not nearly approach its maximum capacity in the meter. With few alterations made in the meter during the experimental stage, it was used to measure the muzzle velocity of rifle bullets.

The meter can be set up and operated by any one who can hook up a radio to the antenna, ground, and plug the cord into an outlet. Operation is as simple as tuning a radio in the home. It is impossible to connect the meter incorrectly.

After the instrument has been set up, and the switch turned on, it takes about one minute for the tubes to warm up. The meter needle moves to the speed at which a vehicle is traveling as it passes through the beam and remains at that point until the reading is cleared by pressing a button. Other passing vehicles do not affect the reading until the meter is cleared. If the meter fails to operate, it is because the light beams are not properly focused upon the photo-cells.

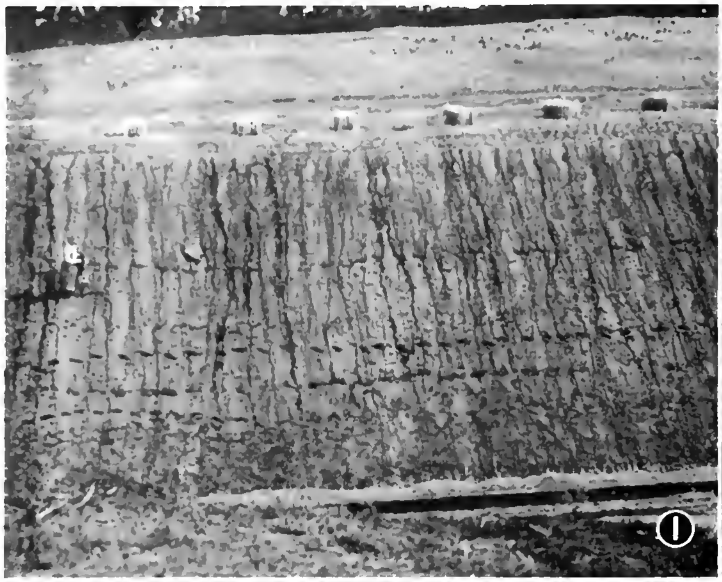
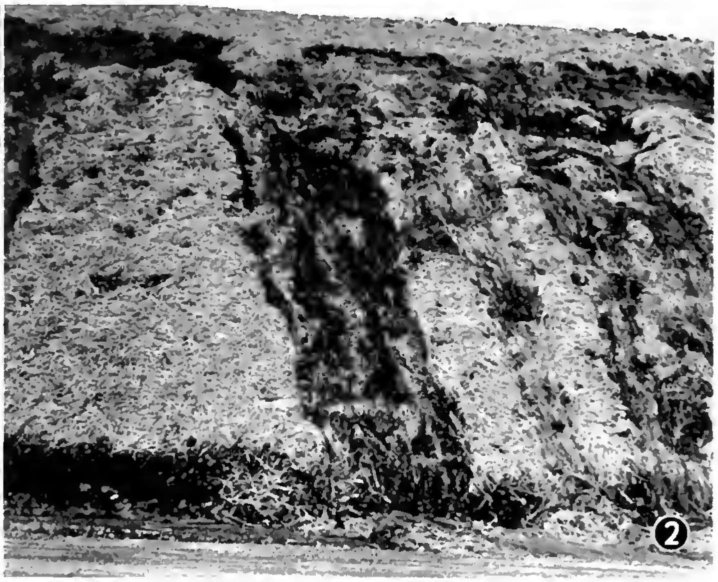
Continuous transporting of the unit in a car may cause the telescopes to get out of alinement. The instrument, however, is fairly rugged and will stand about the same amount of vibration and jarring as a radio.

One of the greatest obstacles in perfecting the meter was the variation in the voltage, which prevented the successful use of dry-cell batteries. To maintain a constant voltage over a long period of operation a vibrator type of supply is used. The output is filtered through a 20-henry choke and 16 and 8 mmf condensers. Two voltage regulator tubes, VR90-30 and VR150-30, are used to stabilize the voltage.

Tubes can be replaced with any standard brand. However, the vacuum-tube voltmeter tube is quite critical as to tube characteristics. It has

(Continued on page 20)

iews of new photo-electric roadside speed timer in action at top. Units of the apparatus are shown below with District Traffic Engineer W. M. Rieth who supervised its development

(1) Erosion gullies formed on a top soiled cut slope by 2.13 inches of rain. Note no intercepting drain ditches. (2) Result of 3 days rain, 3.95 inches in 24 hours, on newly treated slopes. Failure due to lack of bond of top soil to subsoil

Low Cost Vegetative Stabilization of Highway Slope Cuts and Fills

By H. DANA BOWERS, Landscape Engineer

MODERN highway construction with its improved alignment and grades, has necessarily resulted in increased excavation. There naturally follows an increase in the depth of cuts, the height of fills, the quantity of slides and erosion damage and subsequent maintenance costs.

To reduce the hazard and expense of maintaining high, steep slopes, they are being flattened, where possible, to a more natural angle of repose. This flattening, however, has brought about an increase in potential surface erosion by exposing more surface area to weathering action.

Progressively and by experimentation, methods of low cost vegetative erosion control have been worked out under varying conditions.

One of the best examples of the value of vegetative slope erosion control is to be seen on the new construction project between Watsonville and Rob Roy in Santa Cruz County.

This road traverses sharply rolling alternately grassed and heavily wooded terrain. The soil is blow sand containing a small amount of clay and is highly erodable.

Ample evidence was at hand during reconnaissance as to the erosion problems involved. Every break in the natural protective sod or humus covering revealed the ravage of erosion. It was obvious that deviation from standard 1:1 slope construction methods was necessary if a road was to be economically maintained in the existing material.

Cut slopes were designed at $1\frac{1}{2}$:1 and specifications were written to include the salvaging and spreading of top soil. Contract specifications for this item of work follows:

CONTRACT SPECIFICATIONS

"Where designed cut slopes are $1\frac{1}{2}$ to 1 or flatter, the top soil on the natural ground shall be reserved and later placed on the slopes. After the slopes have been staked or outlined by the engineer, the top soil containing the natural grasses, roots, seeds and decomposed vegetable matter shall be removed from the area to be excavated and placed in windrows or stockpiled on both sides of the roadway immediately outside the slope lines. The top soil shall be removed to such depth as to provide sufficient material to cover the cut slopes to a depth of at least six inches (6").

"The cut slopes shall be left in a roughened condition with all debris or loose material removed. Hand sloping will not be required and variations from the planned slope at any point of not more than one-half foot will be satisfactory.

"After the roadway excavation has been completed, the top soil from the windrows or stockpiles shall be drifted down over the surface of the cut slopes in a reasonably uniform manner.

"Quantities of top soil removed and placed in windrows or stockpiles will be included in the quantity of roadway excavation to be paid for. The work of handling top soil will be paid for once only as roadway excavation, which price shall include full compensation for removing top soil, placing in windrows or stockpiles, and also for removing it from stockpiles or windrows and drifting the material over the cut slopes as specified above and no additional allowance will be made therefor.

SIX INCHES OF TOP SOIL

"Where, in the opinion of the engineer, the quantity of top soil available is insufficient to provide a layer six inches thick over the cut slopes, or the top soil is of such character as to render it useless for planting or seeding purposes, a suitable top soil shall be furnished from other locations as designated by the engineer. Excavating and transporting such top soil will be paid for at the contract prices for roadway excavation and overhaul, which prices shall include full compensation for drifting the material over the cut slopes as specified above.

"In all cases of slope treatment, the areas shall be seeded as directed by the engineer and such work of seeding will be paid for as extra work as provided in Section 4, article (e), of the Standard Specifications."

Since the amount of humus bearing top soil was known to be insufficient to provide complete erosion protection, a Federal Aid erosion control day labor project was approved by the PRA to supplement the work done under the contract.

WORK PROCEDURE OBSERVED

This was gotten under way immediately following construction and the following procedure was observed:

1. Commercial 6-10-6 fertilizer was spread on the cut slopes at the rate of 10 pounds to 1,000 square feet.

2. Western Rye grass seed was sown at the rate of one pound to 400 square feet.

3. Straw was spread at the rate of three tons± per acre and incorporated with the slopes by shoving or tucking into the loose soil.

These operations, including materials, cost .0032 cents per square foot or approximately three cents per square yard.

Fill slope treatment varied slightly in that cheaper seed and no fertilizer was used. Barley was sown on the fills followed by the straw cover held in place by the same method as used on the cut slopes. Although high winds were experienced, no loss of straw resulted even before the sprouting of the seed which completely covered the straw and held it permanently in place.

To obtain full knowledge of the value of any type of work the failures as well as the successes and their causes should be discussed. In order to illustrate the accomplishment and results of this project they are presented in chronological order.

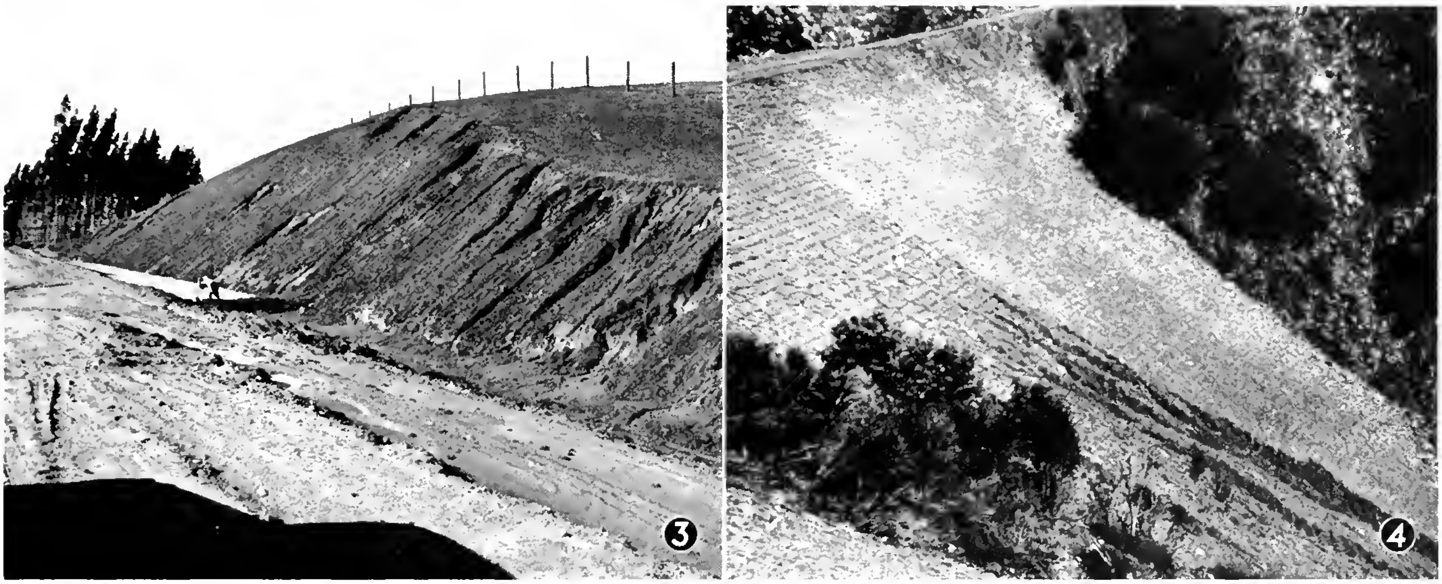
Work was started December 1, 1941. Up to that time 2.13 inches of rain had fallen on the top soiled slopes with a slight gullying effect. See Photo No. 1. No intercepting drain ditches had been constructed which accounted for the more pronounced gullies. Slopes with a high humus content cover, showed no evidence of erosion from this amount of rainfall.

CHRONOLOGY OF WORK

On December 14, 1941, approximately 12 acres of cut slope had been treated. During the 24-hour period on this date, 3.95 inches of rain fell. The heaviest intensity was $1\frac{1}{2}$ inches per hour for a 30-minute period, which according to records was the maximum for a 10-year period. The total for the month was 10.8 inches.

Less than 20 per cent loss resulted from this storm. The appearance of the slopes, however, belied this estimate due to the slipouts occurring mostly at the upper portion of these cuts and sliding down over the straw to the gutter leaving a trail of mud flow behind. See Photo No. 2.

The greatest loss was caused by overflowing water. Broad and shallow intercepting ditches were then constructed and run on flat contours to drain into the natural undisturbed ground. The slipouts were repaired and the gullies packed with straw and seeded.



(3) Loss of top soil caused by first rain. No additional loss from subsequent rains has occurred. Soil is clay loam. (4) Fill slope protected by wattle method. On far half wattles were placed approximately 2 feet apart; on near half 4 feet apart. Note effects of erosion

(Continued on next page)

(5) Barriers that retard the flow of water are not successful. Note deep slip out. Highly erodible soils must not be allowed to move. (6) A down drain poorly installed. Water flows under pipe. Flattened and blanketed with humus material would promote grass growth over which water would flow without scouring

In January, 1942, the rainfall totaled 4.75 inches, of which 2.12 inches occurred in a 24-hour period.

With the exception of occasional gullies caused by overflow from above, originating in swales where down drains were needed to keep the drainage off the slope surface, the failure was negligible. These gullies were again repaired.

In February, 1.57 inches of rain fell with 1.37 inches during a 24-hour period. In March and to date approximately 5 inches has fallen. No additional surface erosion damage to the treated slopes occurred except those areas kept constantly saturated from underground seepage. These areas have continued to slough and cave in and unless the willow stakes planted in these wet spots are effective, will in all probability, continue to do so during the winter months. Where possible, these slopes will be flattened and drains installed.

The northerly section of the project is still under construction and on which no erosion control work has been done. Severe erosion has taken place on both cut and fill causing slough material to encroach on private property. The extreme erodible condition of the soil can be fully appreciated by the fact that the damage to the new work has occurred since the heavy rainfall of December, 1941. Photo No. 6 illustrates the erosion experienced on this section.

The southerly end of the project was not included in the erosion control work. These slopes received no treatment other than top soiling and seeding under the construction contract. All loss of top soil occurred during the first heavy rain of December 14th and no additional loss has resulted since (See Photo No. 3). This would seem to verify the need of a bond between the top soil and subsoil. The soil on this section is clay loam and not subject to the erosion as is the sand of the northern portion of the project.

Intercepting drain ditches at top of slope like above also need vegetative protection

CONCLUSIONS REACHED

Giving due consideration to pertinent factors involved and upon observation of the results of various methods of control under varying conditions in the State, the following conclusions have been reached:

1. Under normal or favorable soil and weather conditions a permanent cover can be economically established on 1½:1 slopes.

2. Where the character of the subsoil precludes root penetration and where saturation occurs, 1½:1 is too steep and failure can be expected. In this case slopes must be 2:1 and occasionally flatter to reduce the pull of gravity on unstable subsoil stratum.

3. Slopes must be in a loose cultivated condition before the application of top soil or other stabilization treatments.

4. The value of top soil as an erosion contral agent is in direct proportion to its humus content. When the humus content of the soil is low, additional humus must be provided.

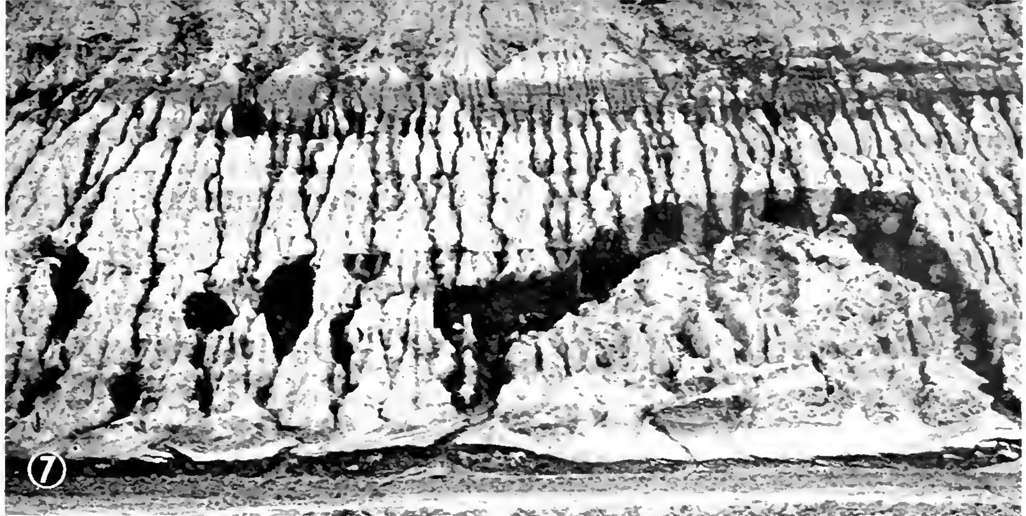
5. To reduce loss of top soil or other applied protection during the first heavy rains a complete bond of the top soil to the subsoil is necessary. Usually the first gentle rains of the season will accomplish this. In the event of heavy down pour, however, the surface application becomes saturated and slips down over the subsoil unless the subsoil is of such character as to absorb the moisture. To prevent this loss, where conditions warrant the cost, a bond may be effected by artificial watering during application.

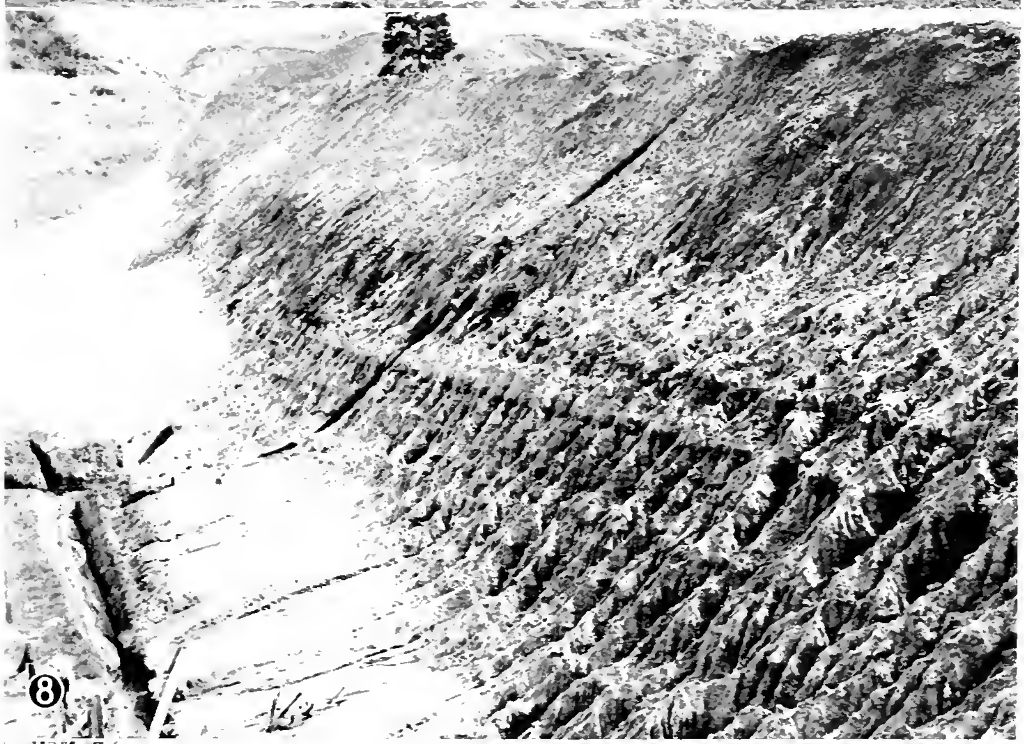
IMPORTANCE OF BOND

6. The thickness of top soil or treatment applied has little direct bearing on the per cent of loss if a bond is effected. This is evidenced by the fact that practically no loss of top soil or other treatment occurs after the first heavy rain. After bonding, only natural erosion gullies form and these are minimized by reason of the existing humus in the top soil cover. A rapid and successful growth of any nature can not be expected when plant food is lacking; therefore, the thickness of top soil applied depends upon growing conditions. Where good growing conditions exist the amount of top soil may be reduced and vice versa.

7. Exposure is most important and dictates in many cases the extent of treatment necessary. Conditions being equal, a northerly exposed slope can be vegetated much more economically than that of a southern exposure. Less humus content is needed to retain the moisture for plant growth on slopes with a northern exposure. Exposures should be con-

(Continued on page 15)





Typical erosion occurring on cut slopes during construction are shown in Nos. 7 and 8. On the same job and same soil 1½:1 cut slopes are shown in No. 9 that were stabilized with top soil, rye grass and straw

Seven Types of Bank Protection Used for Highway Along Santa Clara River

By G. A. TILTON, Jr., Assistant Construction Engineer

IN less than one mile along the Santa Clara River in Ventura County, seven types of recently constructed bank protection serve to protect the State Highway. These installations are as follows:

(1) 30 foot steel rail tetrahedron spur jetties.

(2) Sacked concrete riprap revetment.

(3) Portland cement concrete revetment.

(4) Rock and wire mattress.

(5) Steel rail and cable and rock-fill double fence.

(6) Combination of sacked concrete riprap revetment and rock and wire toe mattress.

(7) Combination of portland cement concrete revetment and rock and wire toe mattress.

Selection and adaptation of each type of bank protection has been based on experience and principles of design outlined in the State Division of Highways *"Joint Departmental Report on Performance of Revetment and Bank Protection" compiled subsequent to the 1937-8 floods in Northern and Southern California.

Steel Rail and Cable and Rock-fill Double Fence

The first type to be installed was the steel rail and cable and rock-fill double fence, constructed in 1938-1939 shortly after the disastrous March, 1938, floods. One thousand fifty-one feet of double fence was built at a vulnerable point where the Santa Clara River overtopped and washed out the State highway roadbed a short distance east of the town of Piru. With no solid foundation available, and the river paralleling the highway, a training type of bank protection was selected. The steel rail and cable and rock-filled double fence type, with an adjustable rock and brush-fill basket between the steel rail fences met the requirements.

Each fence consists of 60 pound steel rails, 30 feet long, spaced 12 feet center to center and driven 23 feet into the streambed, the rails being connected longitudinally with $\frac{3}{4}$-inch steel wire cables. Both the inner and outer rail fence is lined on the outside with 9 feet 8 inches of 58-inch galvanized woven wire fencing. Inside the steel rail fences spaced 5 feet apart, an adjustable basket of galvanized woven wire fencing is fixed to the outer fence, and filled with alternate layers of brush and rock cobbles. When scour under the fence occurs, the rock and brush filler is free to drop into the scoured area.

* July, 1939, California Highways and Public Works.

Sacked concrete riprap, 12 inches thick with rock and wire toe mattress, 8 inches thick and 14 feet 6 inches wide

Portland cement concrete revetment on $1\frac{1}{2}$:1 slope 10 inches thick with rock and wire mattress 14 feet 6 inches wide

The installation cost $10 per foot including deadmen and has proved to be highly efficient. As in all fence types of bank protection, struts of similar construction to the training fence are connected with the bank to interrupt damaging flow back of the fence at times when the training fence is overtopped.

Combination Portland Cement Concrete Revetment and Rock and Wire Mattress

In 1940, two years after the fence type was constructed, a heavy flow in the Santa Clara River began to threaten sections of the State highway above and below the recently installed double heavy fence type, requiring further protection to the newly paved and realigned roadbed.

Downstream from the steel rail and cable and brush and rock-fill fence, the river impinges upon a curving bank. With no foundation available, and an easily eroded vertical bank, the site required a type

Thirty-foot steel rail tetrahedrons, shown in middle ground, and sacked concrete riprap installation in foreground

Steel rail and cable and rock-fill double fence bank protection

of protection that would prevent erosion of the bank and at the same time provide against scour.

Portland cement concrete revetment on a 1½:1 slope, 10 inches thick, protected with an 8-inch rock and wire toe mattress 11 feet 6 inches wide, was selected for this location.

Section of the combination type of slope revetment and horizontal toe mattress was predicated on the theory that the stream flow on the outside of a curve, next to the bank, is directed diagonally downward along the bank and reaches a maximum at the bottom of the revetment where it meets the streambed. If the downward diagonal flow, which is primarily the resultant of the superinduced head next to the bank and the stream flow parallel to the bank, is interrupted at the bottom of the revetment and deflected horizontally by a resistant body, scour at the bottom of the revetment is prevented.

The rock and wire toe mattress not only interrupts and deflects the damaging downward diagonal flow horizontally, but being flexible, has the property of being able to settle into scoured sections at the outer end of the mattress and stop further destructive action.

Experience with toe mattresses in the past three years has been highly gratifying and appears to justify the theory upon which the design is based.

Portland cement concrete in the revetment consists of creek-run aggregate and 4 sacks of cement per cubic yard.

Rock and wire toe mattress is made up of 58-inch Elwood Type I galvanized woven wire fencing bound together with No. 12 galvanized wire ties 8 inches center to center. Three-quarter-inch wire cables connected to deadmen spaced 10 feet center to center back of the revetment are attached to a longitudinal ¾-inch cable to which the mattress is fixed. At the point where the rear edge of the mattress meets the concrete revetment, any fixed connection between them is avoided by providing a weep hole for the deadman cable.

Portland cement concrete revetment cost $12 per cubic yard and the rock and wire toe mattress 40¢ per square foot, exclusive of deadmen.

Economic selection of this combination of types of bank protection is dependent upon availability of local materials for creek-run concrete and rock-fill for the mattress.

Combination Sacked Concrete Riprap Revetment and Rock and Wire Mattress

At the upper end of the original construction of steel rail and cable and rock-fill double fence, where stream flow was threatening the newly aligned highway, a firm foundation for revetment was available for only a part of the distance to be protected.

Sacked concrete riprap revetment, 12 inches thick, protected at the toe with a rock and wire mattress 8 inches thick and 14 feet 6 inches wide, was selected for places subject to scour where no foundation was available and sacked concrete riprap revetment without toe protection was selected where firm foundation was available.

Sacked concrete riprap revetment consists of ordinary secondhand burlap sacks filled with approximately 1 cubic foot of creek run, 4-sack, portland cement concrete, laid in tiers upon a prepared slope. Joints are broken and concrete is of such consistency as to produce sufficient mulch on the outside of the sacks to provide a light bond between them.

One of the most interesting observations of the "Joint Departmental Survey of Bank Protection" made in 1938, was the outstanding success of sacked concrete riprap revetment in Northern California.

Although no definite technical conclusions have been reached as to reasons for the outstanding success of properly placed sacked concrete riprap revetment, several theories have been advanced.

In general, a revetment with a smooth surface tends to increase the velocity of stream flow towards its lower end, which, when released against material presenting a higher frictional factor, erodes and causes serious damages at the downstream end.

The roughness of surface presented to stream flow in any direction, by the broken and recessed sack joints appears to retard the velocity by creating turbulence. The reduced velocity tends to minimize scour, both at the bottom of the revetment where it meets the streambed and at the downstream end of the installation.

Where scour has occurred and where settlement or adjustment of

(Continued on page 15)

Low Cost Vegetative Stabilization of Highway Slope Cuts and Fills

(Continued from page 11)

sidered when salvaging top soil for blanketing the slopes.

8. For best results, the variety of vegetative cover introduced should encourage the rapid run-off of water rather than its retention. See Photos Nos. 4 and 5. Herein lies the value of straw as an initial protection if properly placed. When combed down the slope, the downward slant of the stems hastens the drainage. An excess of straw can be detrimental unless this is done, since it may retain water and cause saturation and slipouts. The grass or grain seed sown, serve only to bind the straw or other humus mulch until the natural grasses, etc., take over. In California the natural dissemination of seeds will rapidly replace artificially sown varieties with few exceptions. Therefore, since it is not possible to purchase in quantity or economically, the seed of the native grasses of the region involved, any economical grass or grain that will serve the purpose for the first year may be utilized.

INTERCEPTING DITCHES

9. Complete protection from drainage water flowing over the slopes must be provided. Intercepting ditches must be broad and shallow for the promotion of grass growth. They should be run on contours where possible and on a flat grade to prevent the cutting action of flowing water. They must also be maintained and kept open, otherwise their use is impaired. Down drains pay big dividends if properly installed. Oil mix alone around the intake, however, does not provide a permanent installation. Wider, flatter, well sodded intakes designed to slow down the cutting force of the water, although slightly more expensive to install, by reason of increased labor, would tend to improve with age rather than to deteriorate and develop cracks that defeat the entire purpose of the installation. (See Photo No. 6.)

10. Surface erosion control is of no value where water comes from within the slopes. Often small seepages can be controlled with water-loving plants such as willow, etc.

11. In sandy soil where no solid stratas exist, root penetration is no guarantee against failure when saturated. Sections the depth to which roots penetrate will slip out. Soils of this nature should be sloped to at least 2:1 to reduce gravity pull and vegetation in the form of vines encouraged that take root at intervals. This, of course, can only be done economically where climatic conditions are favorable. Vine growth tends to hold the slope as a unit. This also applies to fill slopes where sections of luxuriantly sodded fill have been known to slip out 12 to 18 inches in depth.

FILL SLOPE STABILIZATION

There are several types or methods of controlling erosion that have been used on highway slopes. Practically all work done in the past, however, has been applied to fills. This is by reason of the fact that only within the last few years have cut slopes been constructed flat enough to apply practical stabilization.

The factors involved in fill slope stabilization are more favorable than for cut slopes. The fact that the soil has been aerated, improves its adaptability to revegetation, as compared to the hard sterile condition of cut slopes. Fills allow considerable percolation of water beneath the applied protection, which up to a certain point is favorable. Cut slopes have little of this advantage and when conditions become abnormal, some loss can be expected during the establishment period.

The comparatively loose condition of fills, favor the deep penetration and formation of fibrous root systems that tend to tie the slope together. These comparisons must be kept in mind when arriving at a method to apply.

Generally speaking, a good rule to follow in the application of slope stabilization is "a little close together" rather than "a lot far apart."

Photos Nos. 4 and 5 illustrate this axiom. Photo No. 4 consisted of 2″ pipe and Elwood fencing, backfilled with brush, etc., at 10′ intervals.

Photo No. 4 shows a comparison of two types of Wattle control. The near side consisted of Wattles placed 4′± apart held in place with 2″x2″x4′ stakes. The far side of the photo consisted of small Wattles 2′ ± apart held in place with 1′ stakes. This proves the value of a more complete cover and refutes the theory of supporting stakes in compacted fill.

Seven Types of Bank Protection Used for Highway Along Santa Clara River

(Continued from page 14)

material supporting the revetment has taken place, sacked concrete riprap has a sufficiently light bond between the sacks to permit adjustment without serious damage.

Sacked concrete riprap cost ranged from $7.50 to $12.00 per cubic yard prior to the present high price and shortage of burlap sacks.

Steel Rail Tetrahedron Spur Jetties

Previously described types and combination of types provided protection to the highway up to a point where the State highway and river bank begin to diverge.

Above the point of divergence, easily eroded vertical banks of silt, that receded with each storm, presented a growing threat to the highway and head works of the sacked concrete riprap. With no firm foundation available, and being faced with the impracticability of extended and expensive revetment upstream, steel rail tetrahedrons, placed as spur jetties, were selected.

Experience with the permeable type of bank protection along California State Highway System, either as jack straw or tetrahedron spur jetties, or as training jetties, indicates increasing success in locations such as the above where they are particularly adapted. Permeable jetties designed as spurs tend to collect drift and confine scour to the outer units, as well as to retard velocities and cause deposit of detritus back of the jetties.

Steel rail tetrahedrons consist of 30 foot No. 60 used steel rails connected together with ¾-inch cables. Cost per 30-foot unit including cables was $208.

Construction was under supervision of District Engineer S. V. Cortelyou and A. N. George, District Construction Engineer, Los Angeles.

Traveling Highway Bridge Crew Sandblasts and Paints 135 Spans

By T. H. DENNIS, Maintenance Engineer

CALIFORNIA'S traveling bridge-paint crew, organized under Superintendent Carl Markhoff in 1930, has to date sandblasted and painted 135 of the 450 steel structures on the California State Highway System. Up to the latter part of August, 1941, this work had involved sandblasting and painting 11,125,000 square feet of surface, and had required 7,450 tons of sand and 17,100 gallons of paint.

The crew is composed of a bridge superintendent, a foreman, a timekeeper, two structural-steel painters and seven skilled laborers, six of whom sandblast and paint, with the seventh performing general work about camp, such as mixing paints, repairing hose and sprayguns, and servicing compressors. This crew works as either one or two separate units, and is supplemented by six unskilled laborers, hired locally, who serve as watchmen, flagmen, and sand and staging handlers.

The equipment used by Unit No. 1 is a portable outfit mounted on a truck and trailer, which is moved daily to and from the work out of the nearest town or highway maintenance station. The equipment of Unit No. 2 is moved with heavy truck and trailer units under a special arrangement with the headquarters equipment department. It remains at the bridge site during the course of work.

Painting programs are made up annually, based on the recommendation of the bridge department, supplemented by the bridge superintendent's personal estimate of the work and materials required. Allotments are issued for each structure, and upon completion of the work the superintendent makes a final report giving the unit-costs of each item of work in terms of labor, equipment and material.

Special attention is paid to the season of the year, since weather conditions affect costs materially. Bridges along the north coast are painted between June and September, Central Valley structures between October and January, and south-coast bridges between February and June.

Sandblasting is the most expensive item in bridge painting, and the efficiency of the nozzle is of utmost importance. Our experience with the special ¼-inch metal-core sandblast nozzle illustrated has been especially satisfactory. The orifice of this nozzle has been found to increase only $\frac{1}{32}$ inch after 100 hours of service. A new nozzle will use $1\frac{1}{2}$ tons of sand in 8 hours' operation, and when this amount is exceeded by 50 per cent the nozzle is replaced. We find it desirable, therefore, to check the amount of sand used in each sand chamber and the diameter of the nozzle orifice daily.

A recent improvement in this equipment is a shut-off valve, which is fastened to the end of the nozzle for the purpose of shutting off the flow of sand. This saves sand and permits the operator to inspect the work or move staging without shutting off the sand chamber. It is also a safety measure, since the shutoff valve eliminates the hazard of undirected flying sand.

TIME-SAVING DEVICE

A simple time-saving device is a Y-connection used on the sand chamber illustrated, which permits two guns to be operated from the chamber under the regulation of one tender. Flexible hose connections greatly reduce the time of connecting and disconnecting the air lines from sand chambers that must be removed from the bridge deck for the safety of travelers at the close of each day's work.

These connections are particularly helpful when painting bascule structures over navigable waterways. On this type of bridge the 2-inch metal air line is stopped on either side of the hinge and a flexible connection made with a rubber hose. Since most passages are made by small craft, which do not require a full opening, the flexible connection often makes it unnecessary to break hose connections and suspend painting operations. When full opening is required, the connectors simplify and reduce the work of disconnecting and reconnecting the air hose.

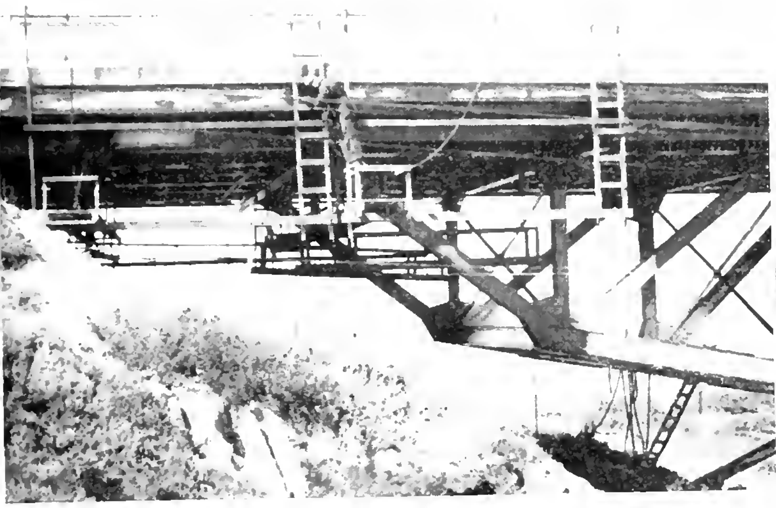
Sand for sandblasting is purchased dried and sacked. Although this represents a cost several times that of bulk material, the differential quickly disappears in the laborious task of drying, screening, and handling the bulk sand. Specifications for Grade B sand require that 95 to 100 per cent pass a No. 20 sieve, 0 to 20 per cent pass a No. 30 sieve and 100 per cent be retained on a No. 40 sieve.

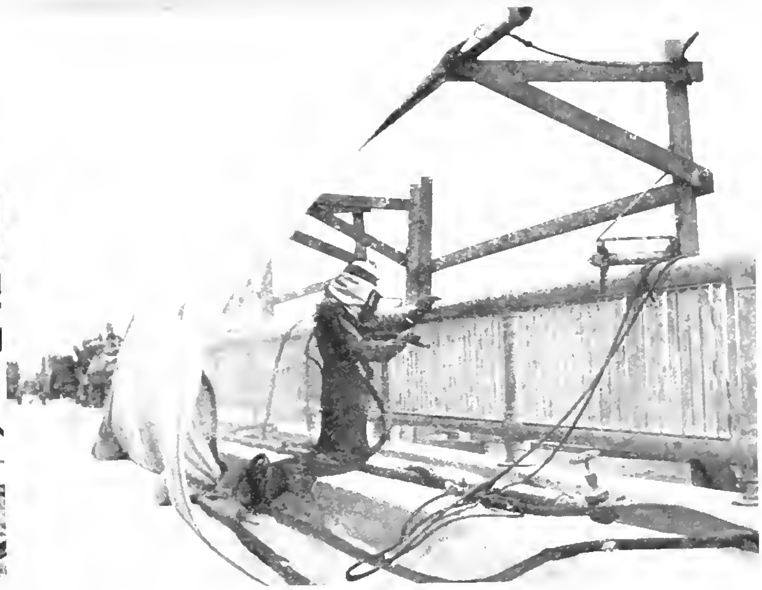
CATWALKS IMPORTANT

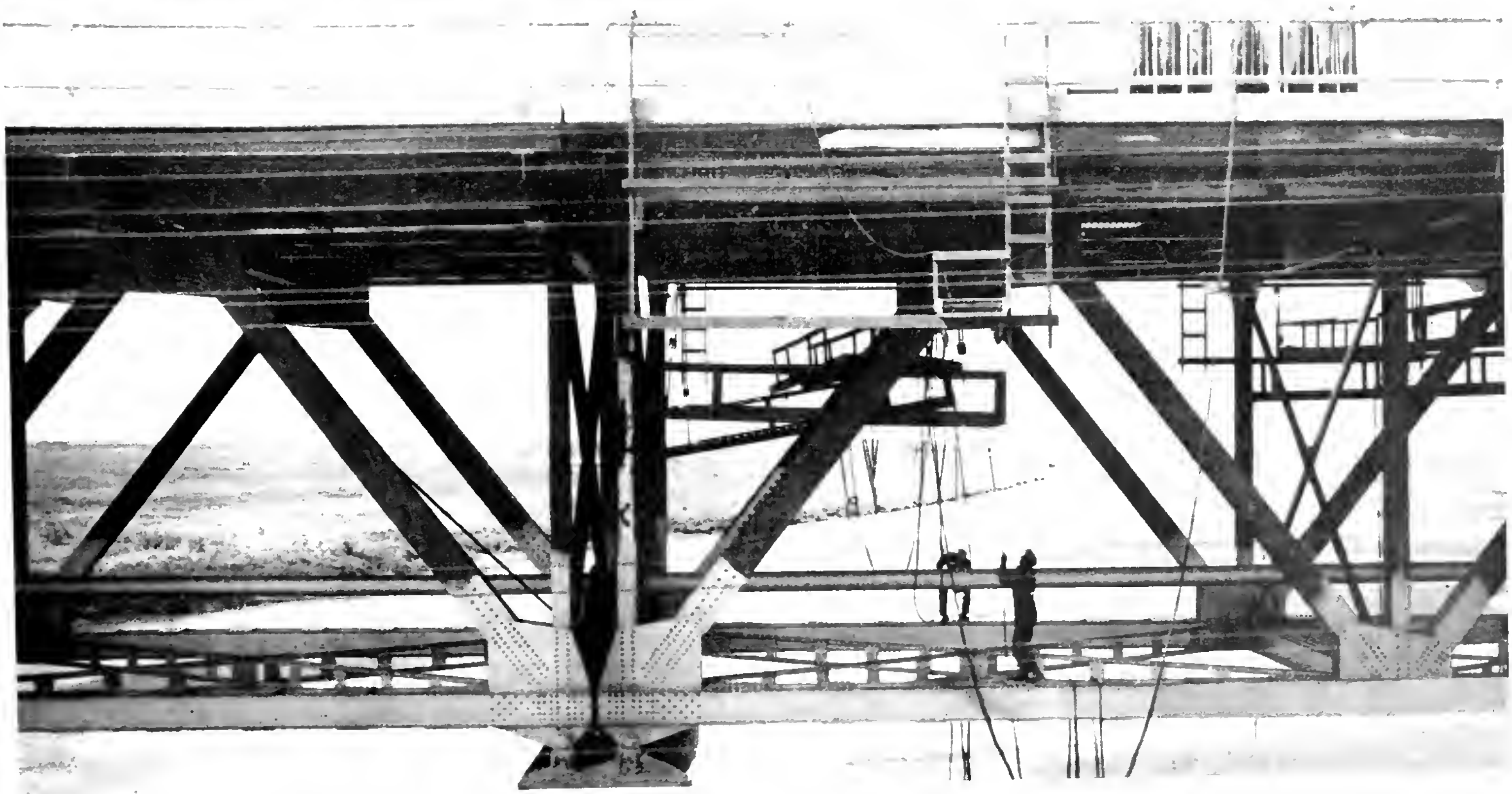
Although staging or catwalks may not be classed as equipment, they are important to the progress of the work and the safety of the men. They are usually built of two 2 x 6-inch timbers laid on edge and floored with 1 x 4-inch boards on 6-inch centers. Railings are made of 2 x 4-inch materials, nailed and bolted.

Catwalks used above deck on truss-type bridges are built somewhat less than panel length in order to clear the plumb posts and sway-bracing. They are raised or lowered by double-sheaved block and tackle suspended from chains attached to the top laterals at the panel-points and hooked up below with a triangular hanger at the end of the catwalk. Triangular hangers with an eye at the apex are recommended, since there is less likelihood that the hook on the blocks will disengage from the hanger.

Catwalks below deck are preferably built longer than the deck







Top picture shows typical set-up of bridge painting equipment and camp. Center (left) painting superstructure from catwalks; (right) sandblaster at work on bridge railing. Canvas screen protects passing vehicles. Bottom—Raising catwalks on steel span over river width; 3 x 6-inch stringers are suitable for a 35-foot length. They are supported by means of needle beams hung from the bottom chord by adjustable steel hangers or straps with holes that match, providing a 24-inch extension. The angle where the hanger rests on the top of the bottom chord of the bridge structure is heavily reinforced to prevent the hanger from straightening. Above this reinforcing is a handle by which the hanger can be moved. Where catwalks can be suspended from a pipe rail, the hanger is made of 2-inch pipe, so that it can be readily rolled along the rail.

EQUIPMENT USED

The following equipment is used for sandblasting and spray-painting minor steel structures of less than 20,000 square feet, and for painting major structures.

1 ½-ton truck with express body
1 3-ton truck with built-in lockers and canopy
1 210-cu.-ft. (actual) air compressor, mounted on 3-ton truck
1 1-ton two-wheel trailer
1 7½-cu.-ft. sand chamber
2 50 to 75-ft. lengths of sandblast hose—¾-in. inside diameter, three ply, 3/16-in.-walled pure gum tube
3 sandblast operators' helmets
1 compressed-air purifier—10 to 35-cu.-ft. capacity
1 ¼-in. sandblast nozzle for each 5,000 sq. ft. of steel surface to be sandblasted (2 for two operators)
4 50-ft. lengths of ¾-in. oil-resistant air hose—three, four or five ply, as needed
3 10-gal. pressure paint tanks (six operators)
7 spray-guns (1 extra for replacement)
12 approved-type respirators
8 75-ft. lengths of ⅜-in. fluid paint hose with ⅜-in. standard pipe-thread connections
8 75-ft. lengths of 5/16 in. air paint hose with ¼-in. standard pipe-thread connections
Also 1-inch pipe for air as needed, staging suitable for the structure to be painted, miscellaneous small tools, rope falls, ladders, wrenches, scraping knives, paint brushes, etc.

The following equipment is used for sandblasting and spray-painting major steel structures of more than 20,000 square feet:

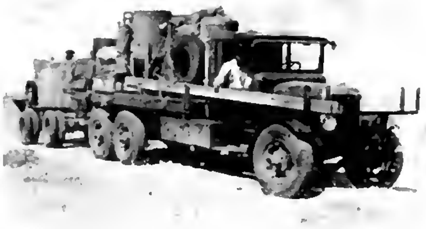
1 ½-ton truck with express body
2 315-cu.-ft. (actual) air compressors
2 7½-cu.-ft. sand chambers
4 50 to 75-ft. lengths of sandblast hose—¾-in. inside diameter, three ply, 3/16-in.-walled pure gum tube
5 sandblast operators' helmets
2 compressed-air purifiers—10 to 35-cu.-ft. capacity
1 ¼-in. sandblast nozzle for each 5,000 sq. ft. of steel surface to be sandblasted
4 50-ft. lengths of ¾-in. oil-resistant air hose—three, four or five ply, as needed
1 air-driven power drill with drills as needed
1 riveting hammer
1 rivet buster
2 50-ft. lengths of ½-in. oil-resistant air hose—three ply
1 portable blacksmith forge with anvil and complement of tools
1 dehydrating outfit
3 10-gal. pressure paint tanks (six operators)
7 spray-guns (1 extra for replacement)
12 approved-type respirators
8 75-ft. lengths of ⅜-in. fluid paint hose with ⅜-in. standard pipe-thread connections
8 75-ft. lengths of 5/16-in. air paint hose with ¼-in. standard pipe-thread connections
Also 2-inch pipe in 20-foot lengths, with tees at each joint, extending from set-up on shore to extreme end of bridge; staging suitable for the structure to be painted; miscellaneous small tools, rope falls, ladders, wrenches, etc.

When the bridge deck is wider than 32 feet it will be found advantageous to swing an auxiliary catwalk from

Equipment Used by Bridge-Paint Unit No. 1

the I-beam stringers as a support for the inside end of the main catwalk. The inner end of the main catwalk remains free, and can be moved along the auxiliary catwalk to any position its length permits. The falls for the auxiliary catwalk are attached to 4x4-inch beams resting on 2x4x12-inch blocks placed on the lower flanges of adjacent I-beams. The 2x4-inch blocks prevent the 4x4-inch beams from slipping off the flanges.

Where there is sufficient water under the bridge, the catwalks can be



Equipment Used by Bridge-Paint Unit No. 2

floated into place and raised to position by means of double-sheaved block and tackle. In moving from one panel to the other, the catwalks are lowered to the water surface or the ground, as the case may be, the steel hangers, needle beams and falls moved to the next panel, and the catwalk floated or carried to place and again raised into position.

This discussion of equipment can hardly be concluded without mentioning the paint agitator. This device uses an air drill to drive a shaft mounting a 6-inch propeller. The shaft extends through the cover of a standard paint container, and its speed and direction of rotation can be regulated as desired.

The foregoing discussion has concerned itself largely with crew organization and equipment. We come now to the paint specifications that have demonstrated their suitability for our work over a 10-year period.

The special primer coat for steel is made up as follows: red-lead paste containing 7 per cent linseed oil, 100 lb.; leafed metallic lead paste, 15 lb.; raw linseed oil, 2 gal.; drier, 1 pt.; mineral spirits, 1½ pt. The weight per gallon ready for application is not to be less than 27 lb.

Our modified second-coat steel paint is made up as follows: red-lead paste containing 7 per cent linseed oil, 100 lb.; graphite, 43 lb.; raw linseed oil, 8 gal.; mineral thinner, 3 pt.; drier, 7 pt.; leafed metallic lead paste, 42 lb. The weight per gallon of this paint ready for application is not to be less than 17½ lb.

Leafed metallic lead paste consists of a minimum of 90 per cent flaked metallic lead, plus or minus 9 per cent mineral spirits and plus or minus 1 per cent stearic acid. It must be of smooth consistency, free from lumps, and it must pass the following fineness specification: maximum retained on a 100-mesh screen, 2 per cent; maximum retained on a 200-mesh screen, 11 per cent; maximum retained on a 325-mesh screen, 20 per cent.

No. 3-B finish-coat graphite (a dull black) consists of 45 per cent pigment and 55 per cent vehicle by weight. The pigment is made up of 95 per cent Type B graphite by weight and 5 per cent carbon black. The vehicle consists of the following percentages by weight: raw linseed oil, 75 per cent; spar varnish, 10 per cent; drier, 5 per cent; turpentine, 10 per cent. The weight per gallon of this paint, mixed and ready for application, must be not less than 10½ lb.

No. 3-C finish-coat graphite (also a dull black) consists of 47 per cent pigment by weight and 53 per cent vehicle. The pigment is 100 per cent Type A amorphous graphite, and the vehicle consists of the following percentages by weight: raw linseed oil, 75 per cent; spar varnish, 10 per cent;

drier, 5 per cent; turpentine, 10 per cent. The weight per gallon of this paint must not be less than 10.7 lb.

TYPICAL PAINT JOB

Let us now describe the routine followed on a typical paint job. Since day-to-day routine varies little, the description will be limited to the set-up of equipment and the start of sandblasting and painting operations.

The structure spans a navigable waterway and is 586 feet long. It consists of two Strauss trunnion bascule lift spans, two counterweight spans and two truss spans. The work order called for sandblasting and applying primer and second-coat paint to 68,000 square feet of surface area, and a finish coat to the entire structure—some 78,000 square feet of surface area.

Materials, such as lumber for staging, tent and screen frames, sand and paint, had been requisitioned in advance by the superintendent, to be delivered to the bridge site when ordered.

While equipment Unit No. 2 was being moved from the last job, the members of the crew drove their personal automobiles to the new work and sought suitable living quarters. When the equipment arrived it was unloaded at the side of the roadway a short distance from the bridge. The following two days were spent setting up the two compressors, laying the 2-inch pipe line for air, and building tents, catwalks and screens.

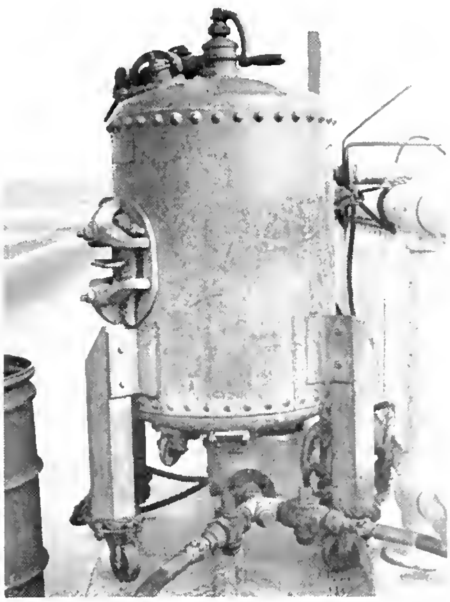
TEES INSTALLED

During this period the sandblast sand and paint were delivered and stored. The compressors were jacked up, leveled and set on blocks to take their weight off the pneumatic tires. Tees were installed every 20 feet and unions every 200 feet in the pipe line, which extended from the compressor over the bridge deck. This insured air delivery at all points and quick replacement of leaky or damaged pipe.

Catwalks and screens were built, since it has not been economical to haul this bulky material any great distance. On the third day stagings were hung in the top of the counterweight truss, two sandblast chambers were moved on to the bridge deck, sandblast hoses and air hoses for the operators' helmets were hauled up on to the staging, and the work was under way.

Two operators worked from each sand chamber, with a skilled laborer at each chamber to regulate the flow of sand and air. Two laborers supplied the chambers with dry sand, which was hauled out to the deck on a $\frac{1}{2}$-ton truck equipped with an express body. No flagmen were required during the painting above deck, since the breeze was strong enough to carry away the spent paint.

After 6 hours of sandblasting, this operation was stopped, since all steel is prime-coated the day it is cleaned. While the painters were



Y-connection used on sandblast chamber permits two guns to be operated under the regulation of one tender. Flexible hose connections (A) save time

greasing their hands and faces preparatory to painting, the steel was cleaned of dust and sand, and the catwalks were moved into position.

PAINTING OPERATIONS

Painting operations proceed at a much faster rate than those of sandblasting. A good painter is able to spray-paint 200 to 300 square feet of surface area in an hour, whereas an experienced sandblaster cleans but 80 to 120 square feet in the same period. One factor contributing to this differential is our insistence that the steel be sandblasted to bright metal, rather than stopping at the bloom.

On completion of the day's painting, the paint pots were removed from the bridge deck, and the catwalks lowered and moved some three panels distant for the following day's sandblasting. This is necessary, since the sand and dust otherwise would mark the previous day's painting.

Two night watchmen were assigned to guard the equipment and stores, screen the recovered sand, clean out the mixing boxes in the sand chambers, wash the spray-guns, and set out and take in warning lanterns.

When sandblasting and painting had progressed to within 8 feet of the deck, screens were placed between the operators and traffic. These were moved along with the work, to prevent interruptions by traffic.

Second and finish coats were applied following a 72-hour interval between the prime and second-coat applications—the number of painters and time of painting being expanded as conditions permitted.

Before sandblasting below deck the steel members were washed with a detergent, followed by an application of clear water, to determine the sound paint. Lacking steam, it was necessary to mix the detergent with water and apply through the sand chambers. The detergent was composed of 47 per cent sodium metasilicate, 40 per cent sodium sesquisilicate, 10 per cent sodium tetraphosphate and 3 per cent nacconal.

COST OF WORK

This operation proved profitable, since it disclosed considerable sound paint, which was covered with grime and dirt. The sandblasting below deck was carried on similarly to the operations above deck, except in the matter of staging, which was hung from the lower chords by hangers or supported on auxiliary catwalks suspended from I-beams.

No unusual provisions were necessary other than the special arrangement of quick-coupling hose connections required for the passage of boats. Only during the passage of large boats was it necessary to remove these connectors completely. No delays were experienced on this particular bridge from either fog or rain.

The job required 60 working days. Costs per square foot of surface area for the various operations, including labor, materials, equipment, rental, idle time and transportation, were as follows: sandblasting, 9.09c.; prime coat, 2.83c.; second coat, 2.32c.; finish coat, 2.83c.; total for these operations, 17.07c.; washing steel, 1.57c.

Average unit-costs of materials were $4.60 per ton for sandblast sand, $2.65 per gal. for red-lead prime coat, $1.75 per gal. for second-coat graphite paint and $1.10 per gal. for finish-coat graphite paint.

The materials provided the following coverages per gallon: prime coat, 370 square feet of surface area; second coat, 450 square feet; finish coat, 450 square feet. A ton of sand cleaned an average of 340 square feet.

Through this operation another important structure was protected for a 10-year period. The crew had the equipment loaded and ready for transport some 4 hours after the last spray-gun was laid down. The men were off in their own automobiles to a new job, where good advance planning again did its best to make the work merely routine.

Roadside Speed Timer

(Continued from page 6)

been found that the 7B7 tube in the voltmeter circuit varies with different brands and even different tubes of the same brand. It is necessary to sort over a few tubes to secure one for replacement in case of failure or damage to the one in the set.

Wilbur Smith, traffic engineer for South Carolina State Highway Department, provided data, diagrams, and results of his early experiments with photo-electric, roadside speed meters, which were used as a basis for further development. The actual laboratory construction and experimental work for this meter was performed by Dr. John Blackburn, Ph.D., Consulting Physicist, Hollywood, California. Much credit is given these two men for their work.

15,000 Chinese Coolies Equal Work of Forty Steam Shovels

Recently some 90 miles of new road needed for the transport of material, for the new Yunnan-Burma railway, was constructed within 50 days. The work was done by 15,000 Chinese coolies supplied only with hoes and baskets; they moved about 3,000,000 cubic yards of dirt in that time. The equivalent work by mechanical means would have needed 40 steam shovels for completion in the same time.—Modern Transport, January 17, 1942.

There are three sides to any question: Your side; the other fellow's side; the truth.

In Memoriam

Charles M. MacDonald

February 18, 1887—April 3, 1942

The friends of Charles M. MacDonald, Highway Maintenance Foreman, were shocked to learn of his passing due to a sudden heart attack at Quincy, California, on April 3, 1942.

Mr. MacDonald was born February 18, 1887 in Montezuma, Iowa. He attended elementary and high schools in Montezuma, and in 1906 entered Iowa State College to study civil engineering.

In 1909 Mr. MacDonald went to work as assistant to the construction engineer with the Southern Pacific Company in New Mexico and Arizona, and in 1912 was assigned to the office of the construction engineer in San Francisco.

From 1918 to 1927 he was employed as cashier and manager by the A. F. Wells Company, Engineers, San Francisco. During 1927 to 1930 he returned to the Southern Pacific Company.

In 1930 Mr. MacDonald went to work for the Western Pacific Railroad Company in charge of accounting on construction.

In 1933 Mr. MacDonald entered the employ of the Division of Highways as a Construction Crew Foreman. While with the State he was located in various districts, and was employed as a maintenance foreman stationed at Quincy when death occurred.

Mr. MacDonald is survived by his wife, Mrs. Mabelle MacDonald in Susanville, a son, Charles MacDonald, Jr., in Stanford University, two sisters, Mrs. Jean Wade of Montezuma and Mrs. Florence Feluts of Western Springs, Illinois, and two brothers, Ross MacDonald of Montezuma and Thomas H. MacDonald, Commissioner of Public Roads Administration, Washington, D. C.

Funeral services and burial took place in Susanville, California.

War Department
U. S. Waterways Experiment Station
Engineer Department Research Centers
Vicksburg, Mississippi

California Highways & Public Works
P. O. Box 1499
Sacramento, California

Gentlemen:

It would be very much appreciated if you could send to the Experiment Station five copies of your magazine, vol. 20, No. 3 for March 1942. The copy already in the Research Centers Library has proved of real value to the Engineering Staff here.

For the Acting Director:

Very truly yours.

Katharine McDiarmid, Librarian

Commercial Use of Highways Contributes $1,190,000,000 Taxes

THE density of traffic on our highways and roads is increased by the wide variety of vehicles using them, and the greater the number of vehicles per day, the less it costs per vehicle, for each contributes to highway construction and maintenance costs by means of tax payments.

Truck taxes for the year 1940 were reported at $476,342,000. Buses paid $38,028,340 of special motor taxes in 1940. Automobile taxes amounted to $1,280,000,000. Since 53 per cent of total passenger car mileage is commercial in nature, approximately $678,000,000 of this amount is paid on commercial use of passenger cars.

This total annual commercial contribution of $1,190,000,000 may be viewed as a direct saving for non-commercial users of passenger automobiles, since much of this large sum would have to be paid by them if it were not collected from commercial users.

About 85 per cent of the traffic on highways consists of passenger car traffic. We would build most highways for that traffic alone. Since they can be used also by trucks, truck-trailers and buses it decreases the cost paid by the passenger car owners.

The inherent advantages of motor vehicles that have been considered, tend to increase the traffic density on the highways and hence decrease the cost per vehicle for all those that use it.

Dump trucks, farmers' trucks, railroad trucks, the workman going to his job, the salesman, etc., use the highways for long and short hauls.

In addition to the contributions to the cost of providing highways received from the numerous classes of traffic using them, there is some contribution of other taxpayers, for whom roads and highways have been provided, in whole or in part, to serve purposes other than transportation.

—*Motor Transportation*

Motor Freight Gains in 1941

Reports from 202 motor carriers in 42 states show that the volume of revenue freight transported in April of 1941 was 1,509,143 tons against 1,111,604 tons in April of 1940—a gain of 38 per cent, according to the Automobile Club of Southern California.

State of California
CULBERT L. OLSON, Governor

Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

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FRANZ R. SACHSE, Assistant Director

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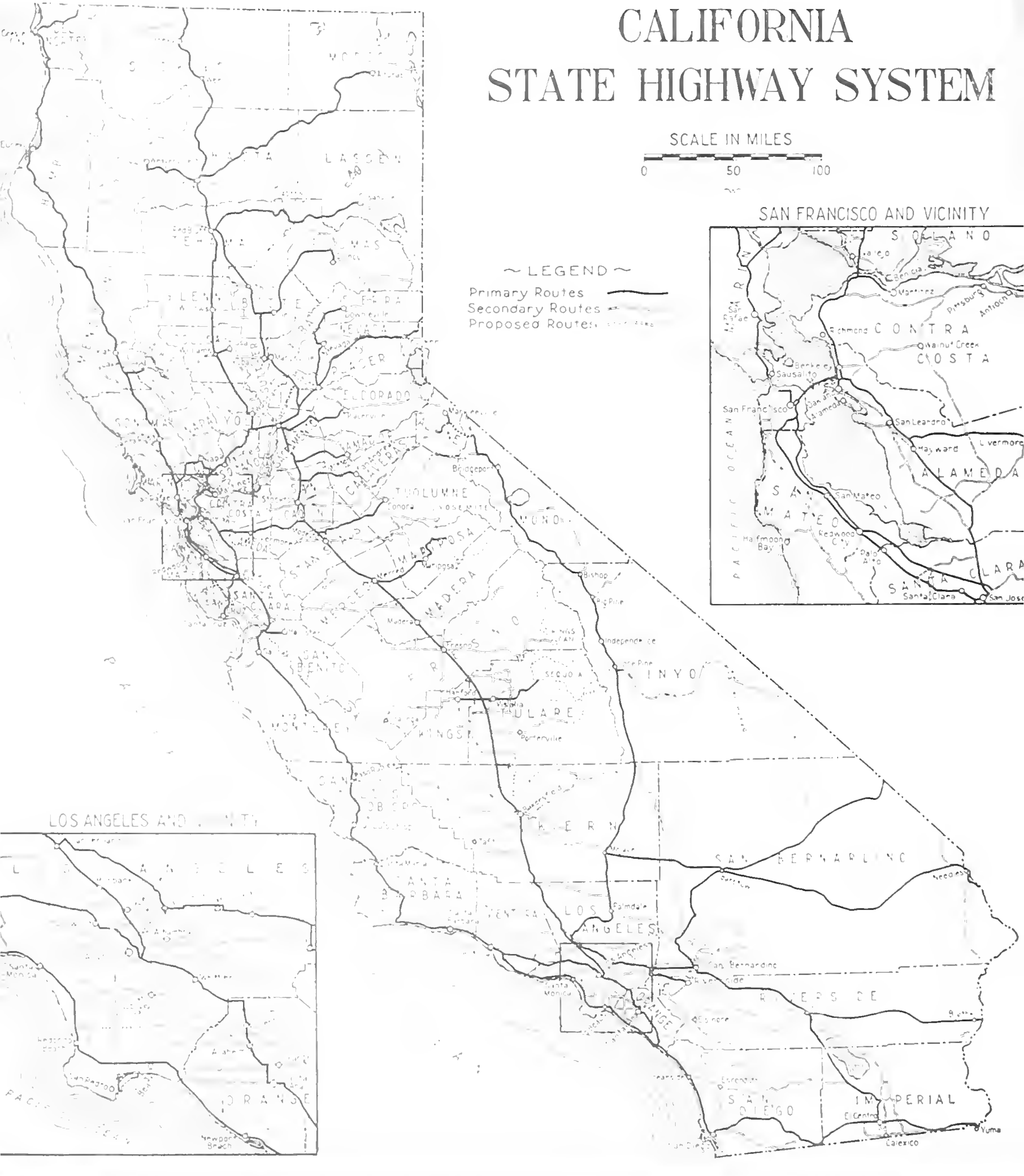

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Department of Public Works, State of California

K. C. ADAMS, Associate Editor

... are privileged to use matter contained herein

P. O. Box 1499, Sacramento, California

No.

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Toll: on Carquinez and Antioch 3ricges Again Reduced by State o 25 Cent Rate for Passenger Cars

ON June 1 motorists began enjoying a 25-cent passenger automobile toll on the Carquinez and Antioch bridges, State-owned toll spans.

Three reductions in vehicular charges on these two bridges were approved by the California Toll Bridge Authority at a special meeting called by Governor Culbert L. Olson and held in Sacramento on May 14th.

Lowering of the tolls was in line with Governor Olson's declared policy of giving motorists full benefit of increasing business on the Carquinez and Antioch spans.

The new rate for automobiles, ambulances, hearses, taxis and light delivery automobiles is 25 cents instead of 30 cents. This is the same toll charged on the San Francisco-Oakland Bay Bridge.

NAVY BUSES BENEFIT

Lowered tolls for buses operated by or for the United States Navy on regular schedules transporting Federal employees to and from their places of employment on Mare Island are now 75 cents instead of $1.

Monthly commutation books for passenger automobiles now cost $10 instead of $10.75.

The new rates for automobiles and commutation books on the Carquinez Bridge apply to the Antioch Bridge. This span already had a 75-cent toll for Navy buses.

REVENUES EXCEED NEEDS

The bond issue for acquisition of the Carquinez and Antioch bridges was $5,943,000. Since September 16, 1940, the revenues from these spans have exceeded the amount required for bond retirement by more than $2,000,000.

Rates for trucks and other commercial vehicles using the Carquinez and Antioch bridges have been reduced twice since the State purchased these spans.

Carquinez and Antioch Bridge Statistics

Bridges Purchased	September 16, 1940
Revenues to April 30, 1942—	
Carquinez Bridge	$2,595,847.51
Antioch Bridge	173,902.76
Total Revenue	$2,769,750.27
Expenses Other Than Bond Interest	$362,678.70
Interest on Bonds	$223,736.25
Excess of Revenue Over Expenses	$2,183,335.32
Improvements	$79,740.34
Total Bond Retirements	$895,000.00
Bonds Outstanding	$5,048,000.00
Bonds Originally Issued	$5,943,000.00
Balance on Hand—Cash and Receivables	*$1,560,207.60
Motor Vehicle Traffic	7,122,707
Vehicular Toll Revenues	$2,764,466.49
Rents and Miscellaneous Income	$5,283.78

TOLL REDUCTIONS

September 16, 1940 ....From 45¢ to 30¢
5¢ for each passenger abolished
May 14, 1942 ..From 30¢ to 25¢

*Includes $351,612.62 cash acquired at time of purchase.

The reductions ordered by the Toll Bridge Authority were recommended by Director of Public Works Frank W. Clark, who is Secretary of the Authority.

"Revenues on the Carquinez Bridge have been so greatly increased by the additional traffic resulting from the toll reduction of September, 1940, and the travel to and from the Mare Island and Vallejo areas," Clark said, "that Governor Olson, as Chairman of the California Toll Bridge Authority, felt that the public should have the benefit of the steadily growing business.

TOLL COLLECTORS INCREASED

"The income from the Carquinez Bridge has mounted to the point where we have ample funds to care for all extra expenses not anticipated in 1940 that have been occasioned by the increased traffic. There is reason to believe that the Carquinez and Antioch bridges will be toll-free considerably before April, 1948, the date when the privately-owned franchises for these structures which the State purchased would have expired.

"Increased business on the Carquinez Bridge has made necessary the employment of more toll collectors and the owners of the bridge bonds have been requested by the Authority to approve of the necessary increase in the operating and revolving fund to provide for the additional operating costs. Bond holders are expected to approve the action of the Authority because it is in line with the best interests of themselves and the general public.

"The excellent financial condition of the Carquinez Bridge is conclusive proof of what efficient public ownership and operation of such a utility can accomplish. The same sort of proof has been established by the Antioch Bridge and, of course, by the San Francisco-Oakland Bay Bridge."

LEGISLATURE CREATED AUTHORITY

The California Toll Bridge Authority was created by the Legislature in 1929, under an act which states it is the declared policy of the State of California to acquire and own all toll bridges situated upon or along any part of the highways of the State with the end in view of ultimately eliminating all toll charges thereon. The act setting up the Authority

Photo Courtesy of Sacramento Union

Photo of Carquinez Bridge on May 21, 1927 when President Coolidge pressed a button in Washington and opened it to 50,000 cars of the vintage of sixteen years ago and prior which crossed it that day

provides that the members shall consist of the Governor, Lieutenant Governor, Director of the Department of Public Works, Director of the Department of Finance, and the Chairman of the Highway Commission.

The first act of this new agency was to launch construction of the San Francisco-Oakland Bay Bridge, which was completed and opened to traffic on October 12, 1936.

As late as January 1939, when Governor Olson took office, a toll of 50 cents per car was being charged on the Bay Bridge. The legal constituency of the Toll Bridge Authority places this agency under control of the Governor immediately upon his inauguration.

GOVERNOR ACTED TO CUT TOLLS

In May of 1939, less than five months after he became Governor and Chairman of the Authority, Governor Olson consulted with Jesse Jones, chairman of the Federal Reconstruction Finance Corporation, in an effort to arrange for reductions of tolls on the San Francisco Bay Bridge.

After correspondence and telephone conversations with Jones, Governor Olson dispatched Director of Public Works Clark to Washington to follow up the negotiations. These were so successful that on June 15th, of the same year, tolls for automobiles were reduced from 50 to 40 cents.

The reduction of tolls had an immediate effect on the stimulation of traffic, which in turn made possible further cuts. On January 1, 1940, tolls were established at 35 cents. On May 25th of the same year, they were cut to 30 cents, and only shortly thereafter, on July 1st, were reduced to the present charge of 25 cents. Not only have toll costs to motorists been cut, but other charges for the use of the bridge, including freight rates, have been materially decreased.

Despite the fact that the Legislature, in passing the Toll Bridge Authority Act in 1929, had declared it to be the policy of the State to own all toll bridges located on its highways, and that same body in 1937 had given specific approval to the acquisition, by purchase or by eminent domain of the Carquinez and Antioch bridges, no effective steps had been taken by the previous administration toward that end.

Extortionate tolls on these bridges had for years discouraged traffic over important highways. Prior to 1938 the toll charged on the Carquinez span had been 60 cents per car plus 10 cents per passenger. In that year, the State Railroad Commission had on its own motion investigated and ordered a reduction in charges to 45 cents per car and 5 cents per passenger.

The Toll Bridge Authority, under the leadership of Governor Olson,

(Continued on page 15)

Speed Restrictions and Group Riding Urged by Traffic Advisory Committee

ONE of California's most important war efforts—conservation of vital war transportation—is steadily gaining momentum under the Direction of Governor Olson.

The State Highway Traffic Advisory Committee appointed by the Governor at the request of Secretary of War Stimson is completing its organization to carry out the duties assigned to it by the traffic advisory committee to the War Department and Joseph B. Eastman, Director of the Office of Defense Transportation.

Californians must conserve automobile tires or, according to Director Eastman's emphatic warning, the Federal Government will be compelled to take drastic action other than gas rationing to curb the unessential use of private cars.

The State committee is composed of James M. Carter, Director of the Department of Motor Vehicles, Chairman; State Highway Engineer C. H. Purcell; Larry Barrett, Chairman of the Highway Commission; and E. Raymond Cato, Chief of the Highway Patrol.

VICKREY EXECUTIVE SECRETARY

Through the cooperation of Director of Public Works Frank W. Clark, full time services of J. W. Vickrey, Traffic and Safety Engineer of the Division of Highways as Executive Secretary, have been made available to the State committee. Vickrey has been impowered to draft any State department personnel he may require for his organization.

The Traffic Advisory Committee met in Los Angeles on June 1st to map out the details for calling upon State agencies for necessary technical and clerical assistants. Justus F. Craemer, president, and Commissioners Rich and Sachse of the Railroad Commission; Dr. Walter F. Dexter, Director of Education; W. D. McIntosh, Southern Area Manager, Council of Defense; F. B. Lessman, U. S. Public Roads Administration; Attorney General Earl Warren; Director of Agriculture W. J. Cecil and Russell E. Berkly, W. P. A., represented their respective agencies.

Speed is the essence of Vickrey's job. With the Nation's supply of rubber rapidly diminishing, Governor Olson has informed the committee that no time can be wasted in attaining the committee's objects, which are:

(a) To prolong the life of all rubber-borne transportation facilities now in use.

(b) Maximum use of mass transportation facilities.

FIVE METHODS PROPOSED

The methods by which it is hoped this goal will be achieved are:

1. Systematic staggering of store, office, industrial and school hours.
2. Planned neighborhood group riding to and from stores, offices, industries and schools based on common destination.
3. Regulation of street and highway traffic, to make possible more safe and efficient use of vehicles.
4. Securing compliance with 40 mile per hour speed proclamations issued by the President and the Governor.
5. Encouragement of individuals, groups and agencies to use any additional methods to conserve vital war transportation.

Group Riding Plan Essential Says Nelson

Everything depends upon production and transportation is a vital factor in the war production program. There must be no breakdown in the Nation's transportation facilities.

The plan for group riding and staggered hours should have the whole-hearted cooperation of every American who uses an automobile. It is the simplest and most workable plan yet advanced for conservation of such facilities.

DONALD M. NELSON
Chief, War Production Board

Director Eastman has requested the mayors of all cities of 10,000 or more population to immediately appoint a local administrator, whose duty it shall be to organize his community for the work outlined by the Office of Defense Transportation. In a letter to all the mayors involved, Vickrey wrote:

LETTER TO MAYORS

"It is requested that you advise this committee of the name of the local administrator and the members of the War Transportation Committee of your city so that direct contact can be made with them by the personnel of this committee assigned for that purpose in order that an early start may be made toward carrying out the great task that has been assigned to the State and local organizations."

It will be the policy of the Highway Traffic Advisory Committee to work through the city administrator within their geographical jurisdictions; to coordinate adjacent jurisdictions where such coordination is desirable from an objective standpoint, and to work directly with industries or groups isolated or remote from city jurisdiction.

The work of the committee will be:

1. To provide technical assistance in methods and procedure.
2. To stimulate initiative action and sustaining activity.
3. To furnish State-wide information through newspapers, radio, moving picture facilities, schools and clubs.
4. To act as a clearing house for exchange of ideas, methods and procedures that are effective.
5. To keep a record of progress made and comparative statistics on results attained.
6. To coordinate the work of all State departments concerned with war transportation through an official to be designated in all such departments to work with the committee and Executive Secretary to the end that the combined forces will be best coordinated to accomplish the objectives.
7. To set up the necessary organization through the assignment of personnel from other departments, it being recognized that there is personnel now employed in the several State departments already trained for any work the committee may be called upon to undertake and that there is neither time to train new personnel nor an available source from which to draw untrained personnel.

Vickrey has established an administrative organization in Sacramento.

(Continued on page 20)

Interesting Trends in Wartime Highway Traffic Shown by Survey

By H. L. KILE, Assistant Traffic and Safety Engineer

INTERESTING trends in wartime highway traffic are revealed in a survey recently completed by the Division of Highways.

The passenger vehicle volume has declined steadily since the first of the year while the traffic of freight vehicles during the first four months of 1942 was 20 per cent more than for the same period last year.

The Division of Highways has long endeavored to keep itself accurately and currently informed regarding the main element of transportation—the traffic that must be served, how much, what kind, its locale, what it does, when, how, and the many corollaries to such questions.

While these questions are at all times of the most vital interest to the highway engineer, and in a somewhat less conscious degree to the public generally, this matter of highway traffic at the moment is of peculiar interest and importance to each and every one of us.

CHARTS REVEAL CHANGES

Aware of this widespread interest, the Traffic and Safety Department has prepared the accompanying charts which graphically show some of the more salient features of what is taking place on our highways as revealed by the actual record of observed facts.

Chart No. 1 presents the record of speed characteristics during three periods: First, the speed pattern which was being followed prior to the enactment in 1941 of legislation increasing the maximum prima facie speed limit from 45 to 55 miles per hour; second, the speed of traffic in the period which followed this change in the upper speed limit; and finally, the situation at present after several months under wartime conditions which have brought increasing changes to all of our normal peacetime activities.

The speed curves shown on the chart are based upon actual observations taken at a large number of locations throughout the entire State Highway System, and are identical for all of the periods.

SPEED PATTERN CHANGES

The places chosen for checking were at points on the highways where no legal restriction zones existed and where it could be assumed that the traffic speed would reflect normal driving habits. While the chart is self-revealing, since all of us become more or less surfeited with chart reading it may be of interest to make brief written comment.

> **Cooperation Needed to Conserve Rubber**
>
> The rubber situation becomes more serious daily. Therefore it is essential that the Nation's present supply of tires be made to last many times longer than it normally would. The plan outlined by the Traffic Advisory Committee to the War Department makes it easy for war production workers and other members of the civilian population to cooperate with their Government by actively promoting such conservation. I am all for it.
>
> LEON HENDERSON
> Price Administrator

It will be noted that there is no essential difference between curves A and B, representing the periods before and after the increase of the maximum speed limit from 45 to 55 miles per hour. Some apprehension was expressed that the legal increase would result in generally higher speeds; however, as will be seen, the comparative checks, taken some months after the enactment went into effect, indicate quite definitely that the motorist generally made little o[r] no change in his driving speed.

''Average'' and ''Critical'' spee[d] remained practically the same. I[n] fact, the changes were found to b[e] so slight that to all intents and purposes the two curves are identical. It may be explained that as here use[d] the ''Critical'' speed is that spee[d] below which 85 per cent of all vehicle[s] are found to be traveling.

MORE DRIVING UNDER 40

In marked contrast to the coinci[dence] throughout the lengths o[f] curves A and B, is the very clea[r] departure of the present speed pattern from that which was found t[o] exist in November, 1941. The differences in ''Average'' and ''Critical'' speeds are respectively 4 and 5.1 mile[s] per hour. These decreases, whil[e] definitely appreciable, may to th[e] casual reader appear less significant than they really are when more carefully reviewed.

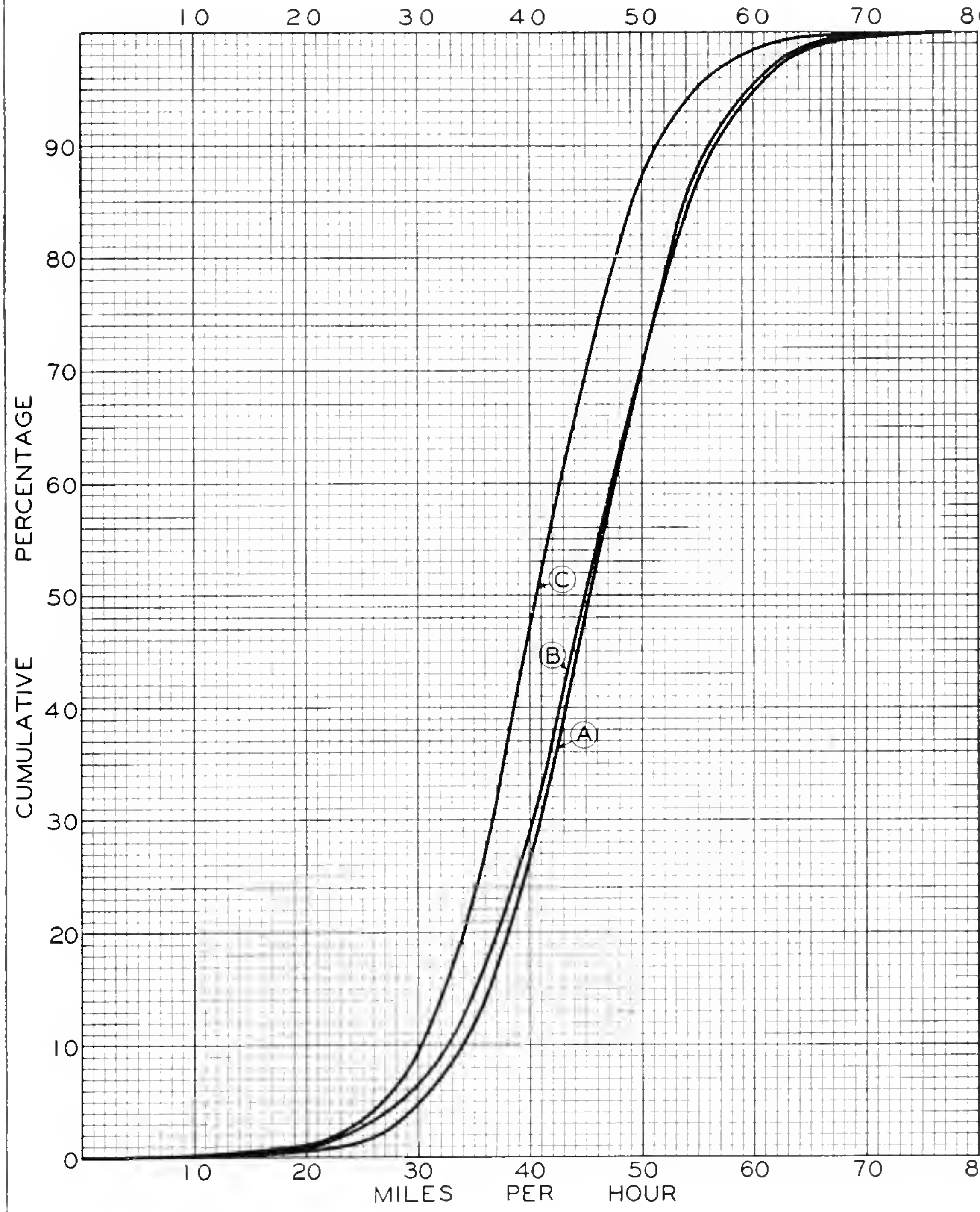
Obviously there is always a considerable percentage of motor traffi[c] which travels in the lower spee[d] brackets regardless of what the maximum permissible speed may be.

It will be noted that in November, 1941, approximately 29 per cent of all vehicles were found to be traveling under 40 miles per hour, leaving 71 per cent moving in excess of that speed. In May of this year we found that only 52 per cent are now going over 40, a reduction of 19 per cent of all vehicles.

When we consider only the percentages of the total which were found to be above 40 in November, 1941, the present check indicates that approximately 27 per cent of the drivers have dropped their speed to below 40.

The change of speed in the upper brackets, which of course is the only place where such change was sought or desired, is even more marked when

(Continued on page 7)



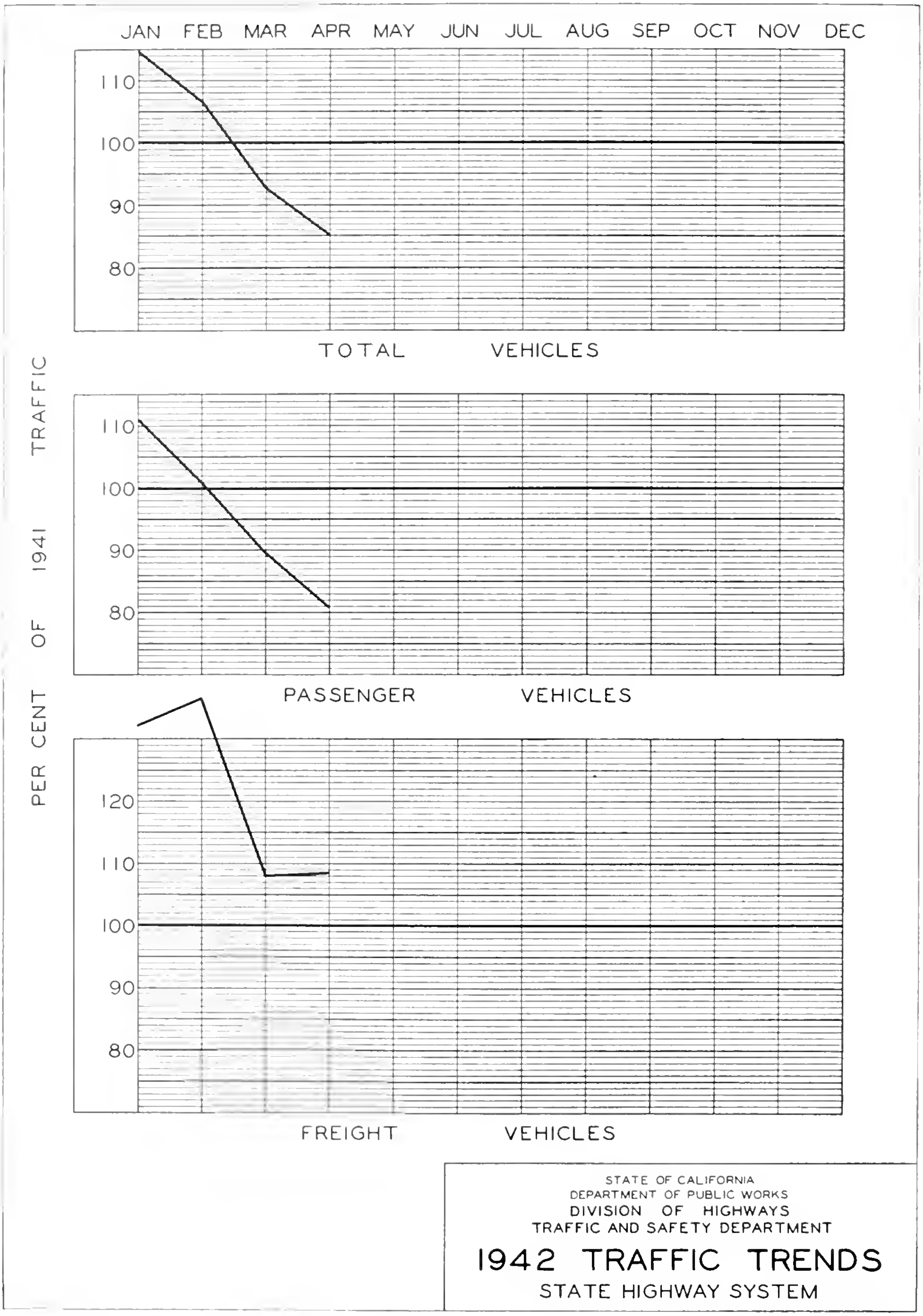
	AVERAGE SPEED	CRITICAL SPEED
(A) PRIOR TO JUNE 1941	47.7	53.8
(B) NOVEMBER 1941	47.3	54.3
(C) MAY 1942	43.3	49.2

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
TRAFFIC AND SAFETY DEPARTMENT

SPEED CURVES

RURAL STATE HIGHWAY SYSTEM

The curves A, B and C on this chart show highway speed pattern changes from June 1941 at 45 m.p.h. limit to November at 55 miles limit and after Pearl Harbor as explained in the accompanying article



This chart shows a decrease in total highway traffic volume from an all-time peak in 1941. In April 1942 passenger vehicles decreased 19 per cent and freight vehicles increased 8½ per cent over April 1941 we consider the 45 miles per hour group. Here we find that in November, 1941, exactly half of all vehicles recorded were above 45. Our May check shows that this percentage has declined to 30 per cent, showing that 60 per cent of all who formerly drove above 45 have now cut their speed to less than 45.

OTHER TRAFFIC TRENDS

The significance of these changes or the implications which may or may not be drawn from these or other comparisons of the charted curves, are wholly outside this present article, which is limited to the simple presentation of observed field data.

In Chart No. 2 are shown other traffic trends, in many respects of equal or greater interest than the question of traffic speed. Here are depicted the changes in traffic volume, both overall and by further breakdown into passenger-carrying vehicles and freight-carrying vehicles. The figures in all instances represent total traffic including both civilian and military. The comparisons made are between 1941 and 1942 and necessarily can at present cover only a four-month period.

One point to be emphasized in considering this chart is that 1941 traffic is shown as 100 per cent, which might, unless attention is called to the matter, be casually accepted as "normal." But 1941 can not on any basis be considered as a normal year for highway traffic in California. In volume both for passenger and freight vehicles the State Highway System in California in 1941 carried an all-time peak, being approximately 9 per cent over 1940 traffic and 19 per cent more than that of 1939, prior to the effect of the marked impetus in all activities brought about by the present world emergency.

LOWER TRAFFIC VOLUME

It is to be noted that the passenger vehicle volume, which at the start of the year was well above the like period in 1941, has steadily declined until at the last recording it was 19 per cent under that of April, 1941. Taken as a unit, the total passenger vehicle traffic for the first four months of 1942 is 5 per cent under the like period for 1941.

The record with respect to trucks and trailers presents a different picture. Freight traffic in January was 32 per cent above January, 1941. This percentage increased to over 36 in February, declined to 8 per cent in March, and rose in April to almost 9 per cent. For the four-month period our highways in 1942 have carried over 20 per cent more freight vehicles than during the same four months in 1941.

What direction trends may take in the immediate or distant future must to a large measure be a matter of mere conjecture, for all readers are acutely aware of the many wholly unpredictable conditions which may at any time compel a radical change in present habits or practices.

U.S. Advisory Staff Directs Cooperation

The Highway Traffic Advisory Committee to the War Department under the chairmanship of the Commissioner of Public Roads, Thos. H. MacDonald, has accepted the Nation-wide responsibility for the execution of the war transportation conservation plan. A fulltime staff has been assembled in Washington and this staff, reinforced by experienced personnel in the several States, including those from the Highway Planning Survey, are available to assist the State and local administrations.

JOSEPH B. EASTMAN
Director, Office of
Defense Transportation

INTERESTING AND INFORMATIVE

Long Beach, Calif.

California Highways
and Public Works,
Sacramento, California.

Gentlemen:

I have been cognizant of your fine publication for many months through occasional copies which I see at friends and business offices which I frequent.

I feel your method of informing citizens of the work of your department is both comprehensive and instructive.

I am a native son and travel extensively throughout the State, so really enjoy the improvements and safety factors.

Will you please place my name on your mailing list.

Yours very truly,

NORMAN H. OLGIE,
Aeronautics Instructor,
Long Beach Public Schools.

Need of After-War Planning Stressed by Thos. H. MacDonald

"IT IS apparent that the requirements for the procurement of needed materials and equipment for the entire field of automotive transportation are now, and for a long time to come will remain, largely subject to the restrictions and limitations necessarily imposed on the national economy by the war effort," says Thomas H. MacDonald, Commissioner of Public Roads, in April American Highways. "It is confidently expected that the more intensive use of existing motor vehicle equipment and highway facilities, coupled with the enforced postponement of much needed replacement for an indefinite period, will build up a latent reservoir of needed production after the war.

"Planning for the future peace, therefore, must of necessity be a part of our all-out war program.

"Foremost on the 'shelf' of public works to be made available in the future, not alone in response to pent-up needs but by reason of long-standing neglect, is the type of project concerned with urban redevelopment and housing. Conditions resulting from rapid changes incident to modern industrial development and in methods of transportation have been permitted to lapse.

"Problems of traffic congestion, of the lack of coordination of all transportation, of inadequate parking space for motor vehicles, of over-dense populations and needed recreational areas, have not been frankly met in the past, can not be adequately dealt with in the present emergency, but will have to be faced in the future.

"The need for the extensive replanning and rebuilding of our American cities and towns will require the combined efforts of our several administrative agencies of Federal, State and local government together with the maximum aid of private enterprise. It is to be hoped that such rebuilding may be the result of rationalization of our needs rather than the result of the wholesale devastation that is war.

Long Beach Traffic Circle Improvement Eliminates Bad Intersection Bottleneck

By W. L. WELCH, Assistant District Office Engineer

COMPLETION of reconstruction work on the Long Beach Traffic Circle at the intersection of State Highway Routes 60 and 168 east of Long Beach, at a cost of $31,262, and acceptance of the work by Frank W. Clark, Director of Public Works, on April 30, 1942, has eliminated another bottleneck between the defense worker and his job in one of the most vital industrial areas of southern California.

The original Traffic Circle, one of the first of its kind in the State, was constructed under the supervision of the Division of Highways in 1934. Although at that time it was considered a great forward step in handling traffic, increased speeds and further advancement in the science of providing for unimpeded traffic flow, coupled with the tremendous increase in population and consequent traffic densities in this area, had made it totally inadequate for present day needs.

BASIC DESIGN SOUND

That the basic design was sound has been proven by the ease and economy with which this facility was altered, and by the increased ease and speed with which traffic now negotiates the improved traffic circle.

The original conception of the Traffic Circle contemplated six entering highways; of which only three were constructed, and permitted unlimited access to the Circle itself from roadside businesses as they might develop. Through cooperative agreements between the State and the property owners, the Los Angeles County Regional Planning Commission, and the Planning Commission of the City of Long Beach, neither Pacific Coast Highway (State Street) nor Hathaway Avenue will be extended east of and northwesterly of the Inner Traffic Circle, and all access to property abutting the present circle will be obtained by way of an outer circle constructed by the City of Long Beach and the County of Los Angeles. This outer circle consists of 30-foot x 3-inch plant-mixed surfacing on an 80-foot right of way.

In reconstructing the inner Traffic Circle it was not found necessary to increase the diameter. By altering the superelevation and by increasing the radii of the curb returns at the entrances to the circle, it has been possible to double the entering speeds. Traffic islands placed in the proper position in the various entering throats channelize the traffic and prevent collisions between vehicles already in the circle and those entering it. Ample distance is provided for cars to weave into the desired lanes.

INCREASED SUPERELEVATION

Increased superelevation was provided by placing asphalt concrete varying from a minimum of 0.17 feet to whatever depth was required to obtain the necessary amount of superelevation. Where new pavement was necessary due to increasing the radii of curb returns at the entrances, an asphalt concrete surface on a Portland cement concrete base was constructed. New curbs and gutters were built around the outer periphery of the circle, and all traffic islands were curb. Both Lakewood Boulevard and Pacific Coast Highways (State Street), Routes 168 and 60, have a 4-foot positive central division strip for some distance northerly and westerly of the Traffic Circle, thus further reducing possibilities of conflict.

The Traffic Circle is illuminated by three floodlights, positioned so that there is no glare at any time into the eyes of approaching drivers. Flashing beacons and ruby reflectors give additional warning to the driver at island points and other places of possible conflict. On Pacific Coast Highway (State Street), Lakewood Boulevard, and Hathaway Avenue neon signs placed approximately 500 feet from the circle proper advise the approaching motorists of its proximity.

HIGH TRAFFIC COUNT

The acquisition of the right of way for the outer circle and ingress and egress rights to the inner circle presented a very interesting right of way problem.

On the inner circle adjoining property owners had rights of ingress and egress to their properties, but the traffic was fast-moving and presented a hazard in its use. Several meetings of the adjoining property owners were held and it was finally agreed that they would all enter into a cooperative agreement by donating the necessary land and rights of ingress and egress to the inner circle if an outer circle were constructed on which they could locate their various businesses. With the safety and facility of use of the new improvement these owners have expressed their gratification of this new improvement to the district and feel that this improvement will develop the area considerably.

Storm waters approaching the circle from the north and west are carried under the pavement and through the circle by means of a concrete lined open ditch discharging into a reinforced concrete box culvert near the Hathaway Avenue entrance. The area within the inner curbs has been planted with trees and shrubs by the Park Department, City of Long Beach.

Traffic counts taken last July indicate a maximum of 34,384, 27,500, and 19,897 vehicles on Hathaway Avenue, Pacific Coast Highway, and Lakewood Boulevard, respectively. Due to expansion of various defense activities in this area, vehicle use of the Traffic Circle has undoubtedly increased, and the ease and rapidity with which this increased traffic is now handled is a glowing testimonial to the soundness of the original design and to the recent alterations which have been made at this location.

Views of reconstructed traffic circle at intersections of State Street, Lakewood Boulevard and Hathaway Avenue in Long Beach which now consists of a circle within a circle. At top—channelization at State Street entrance. Below—Hathaway Avenue approach

Many large, beautiful trees were saved in construction of the division strip on new 4-lane highway section through Visalia

New Divided Highway Completed on State Highway Through Visalia City Limits

VISALIA, county seat of Tulare County, celebrated on May 15th the opening of a short section of new State highway within the city limits. Officials of the State, city, county, and auto clubs enjoyed with a group of Tulare County citizens, the ceremony marking the completion of this highway construction, which now affords a safe and direct routing of traffic at Visalia.

The project begins at the westerly city limits on State Sign Route No. 198 and follows easterly along Mineral King Avenue to its intersection with Conyar Street, a total distance of some 3,800 feet.

The improvement widened an existing street, replacing an oiled road with an asphalt concrete pavement. The four-inch base for the pavement was a blended sand, plant-mixed with RC-1. Below this had been placed a layer of sandy imported borrow of sufficient depth to insure proper support, over an adverse soil. On this base an asphalt concrete pavement was laid.

Together with a previously completed Division of Highways contract to the west, this project has made a decided improvement in the routing of traffic to and through Visalia.

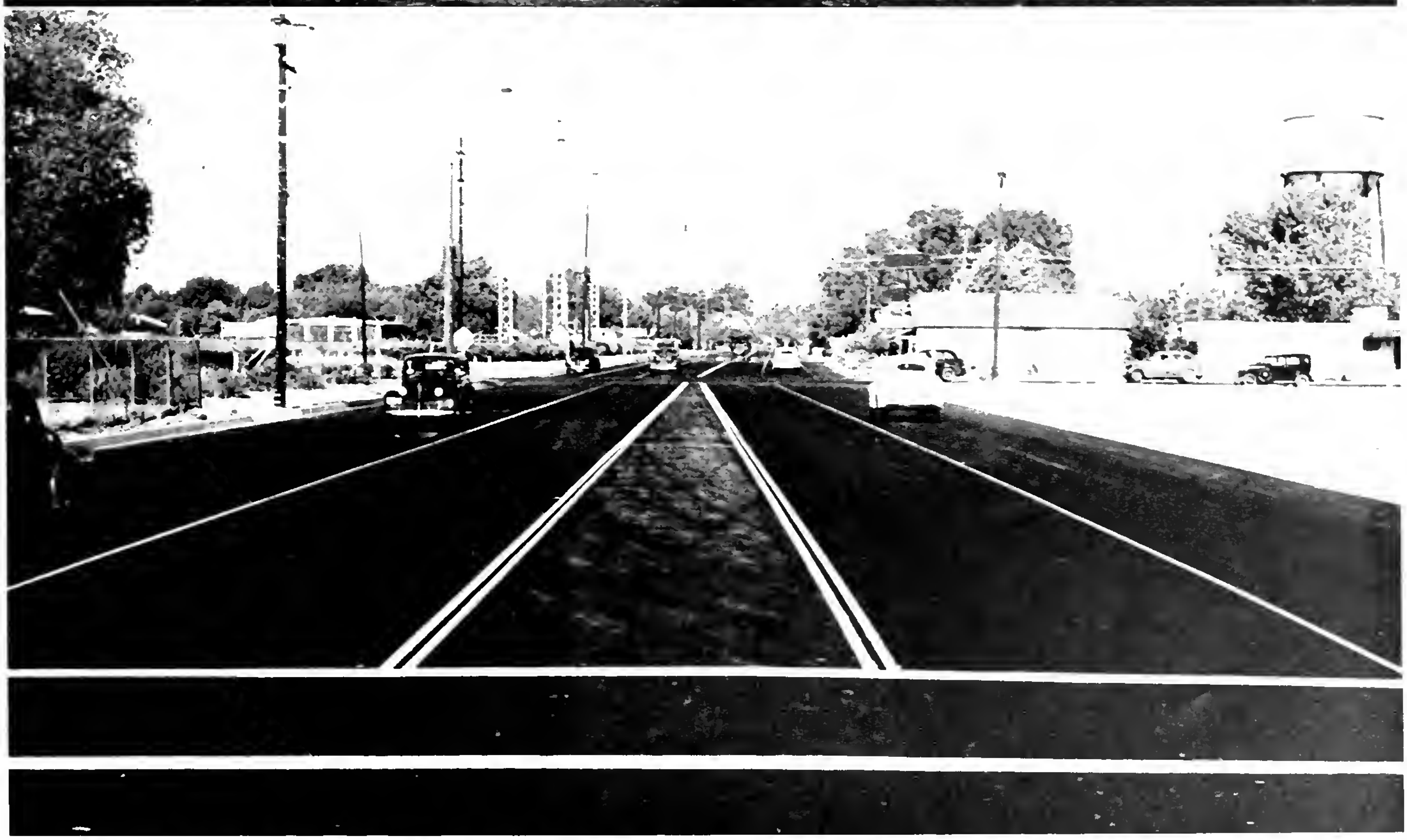
Through the easterly portion of the project where private building is further advanced than in the westerly part, an undivided street section was used. This portion was surfaced as elsewhere, with asphalt concrete and is 61 feet wide between curbs.

The improvement to the west of this project was of the four-lane divided highway type and for the westerly portion of the new contract a divided highway construction was used. The width between curbs in this portion is 37 feet for the northerly roadway and 31 feet for the southerly one.

Central islands 10 feet wide are outlined by concrete curbs. Many large, beautiful oaks are protected by the central island separations, add to the beauty of this approach to Visalia, located on the rich delta of the Kaweah at the approach to Sequoia National Park.

The project is designed to bypass the central business section of Visalia,

(Continued on page 18)



Top—Wide, curbed central island separates the new 4-lane section from the existing road on Mineral King Avenue in Visalia. Below—View of the easterly section of the improvement. The full street width is 64 feet between curbs

Funds Voted to Repair 200 Miles of Highways Damaged by Heavy Traffic

URGENT requirements of the Division of Highways for funds to immediately repair and resurface highways which have been damaged by heavy wartime traffic were recognized by the California Highway Commission at its meeting in Sacramento on May 27th. The commission allocated $1,517,650 for the purpose.

The commission approved a list of necessary repair jobs on 17 highways in northern and southern California which were submitted by T. H. Dennis, Maintenance Engineer of the Division of Highways. Eight of these are on the strategic network in the north three on the primary, and five on the secondary highway systems. Two are on nonstrategic highways on the north primary system and four on the north secondary system. The remaining three projects are on nonstrategic roads on the south secondary system.

Commenting on the action of the commission, Director of Public Works Frank W. Clark said:

"It is the desire of the Highway Commission and the Department of Public Works to cooperate 100 per cent with the Army and the Public Roads Administration in highway construction during the war emergency. Therefore we are devoting all-out time and attention to work urgently required by the Army and Navy.

"However, the Division of Highways will proceed with the purchase of rights-of-way for all budgeted projects and making the necessary surveys and plans in order that when the war is ended California will be in a position to immediately launch the building of highway projects which must now be postponed if we are to give all-out effort to the War Defense Program. Under this policy there will be no delay after the emergency in starting a huge highway construction program. It is probable the commission will have to make other revisions of the budget as the war goes on."

Summary of Proposed Projects for Restoration and Repair of Surfacing Including Incidental Work on Shoulders

Location of work	Miles	Description of work	Estimated cost
STRATEGIC NETWORK			
Primary North			
II-Las-29-B—Between Coppervale and Susanville	12.26	Restore base and replace surfacing	$131,000
III-Yol-7-BC—Cache Creek to Bretona	5.15	Restore base and surfacing	62,000
IV-SM-68-SM,C,Bmt—North City Limits Redwood City to Fifth Street, San Mateo	6.43	Level and restore surfacing	170,000
		Total Primary North (Strategic network)	$363,000
STRATEGIC NETWORK			
Secondary North			
II-Sis-72-BC—Between Cougar and Dorris	35.15	Restore base and replace surfacing	$156,500
IV-CC-106-A—From Route 14 to ¼ Mi. West Christie Underpass	3.60	Restore surfacing	75,000
IV-SCl-32-BC—From Route 22 to Pacheco Creek	7.40	Restore surfacing	47,300
X-Mer-32-C—Los Banos to Madera Co. Line	13.70	Restore base and replace surfacing	140,000
VI-Mad-32-A—From Merced County Line to Califa	15.70	Restore base and replace surfacing	60,000
		Total Secondary North (Strategic)	$478,800
NONSTRATEGIC HIGHWAYS			
Primary North			
II-Sha-28-AB—From Route 3 to Montgomery Cr.	20.50	Restore base and surfacing	$73,400
III-Yol-7-A—Winters Wye to Willow Slough	5.87	Restore base and surfacing	70,000
		Total Primary North (on Nonstrategic highways)	$143,400
Secondary North			
III-Pla,Nev-38-BC,A—Tahoe City to Route 37	10.0	Restore base and surfacing	$136,000
III-Sac-98-A—Sacramento to Route 3	5.15	Restore surfacing	68,000
VI-Fre,Kin-10-EF,BC—From Oil King School to Hanford	31.0	Restore and repair pavement and shoulders	140,000
X-Mer-41-C— Fresno Co. Line to Route 32	4.25	Restore base and surfacing	30,000
		Total Secondary North	$374,000
Secondary South			
V-SB-56-ABCD—Las Cruces to Orcutt	14.70	Restore surfacing and shoulders	$84,300
VI-Tul-134-AB—From 7.0 Mi. West of Tulare to Lindsay	4.50	Restoration and repair surfacing	31,000
XI-Imp-202-A—From Seeley to Mt. Signal	4.40	Restore and repair surfacing and shoulders	43,150
Total mileage	199.76	Total Secondary South (Nonstrategic)	$158,450

This includes $20,000 already allocated for grading and drainage which it is now proposed to apply to surface repair.

Highway Picture As It Looks Today Changed by Drastic War-time Conditions

Representing State Highway Engineer C. H. Purcell, Senior Highway Engineer John G. Meyer addressed the convention of the Supervisors Association in Los Angeles on May 21st on the subject "EFFECT OF WAR EMERGENCY ON HIGHWAYS." Mr. Meyer presented a comprehensive view of the highway picture as it looks today under drastic changes compelled by war-time conditions.

By JOHN G. MEYER, Senior Highway Engineer

VARIOUS guesses were made about a year ago on the probable effect of the Defense Program on highway construction and maintenance. Like most pre-war guesses they were too little. The Nation's all out war effort is having and will have a much more drastic effect on State, county and city road building than was ever anticipated.

The budget of the State Highway Department was made April, 1940, for the period July, 1941, to June 30, 1943. Rapidly rising costs, plus required partial adjustments to a defense effort necessitated budget revision in November, 1941. On the basis of this revision the budget included major construction in an amount of approximately $38,000,000.

In addition to this regular work we were authorized to survey and prepare plans and specifications for approximately $45,000,000 worth of access roads serving the many Naval and Army camps, cantonments, air field and other military establishments as well as war industrial plants and raw material sources. More recently the Division has been called upon to prepare engineering data in connection with construction of a substantial program of flight strips on airfields adjacent to roads.

ADVANCE PLANNING

The foresight in authorizing preparation of these plans was fortunate, because we are able to immediately proceed with construction as the funds are made available by the Federal Government. Consequently, a very substantial part of the access road program in the State area is now under construction or completed. When and if the Government provides the funds, we will be able to complete the access and flight strip program in the State.

We find, following Pearl Harbor, the highway picture changing rapidly due to some six factors as follows:

1. **Increasing costs**
2. **Material scarcities**
3. **The Access Road Program**
4. **Highway Revenue decrease**
5. **Increased Highway Maintenance costs**
6. **Greater emphasis on Defense Highways**

The rise in price of materials, wages, and other factors has increased construction costs probably in the neighborhood of 30 per cent over 1940 costs. Along the same lines we are getting fewer and fewer bids on State highway work. The road contractors are pretty well tied up in airport, dock and cantonment construction. How long this status will continue is difficult to anticipate.

QUESTION OF PRIORITIES

To mention material scarcities brings up the question of priorities which is a headache in itself. Somebody defined priorities as the right to ask for something you can't get anyway. However, unless you have a priority rating it is almost impossible to construct anything today. Sugar, car and tire rationing has brought home to the layman public the seriousness of material scarcities. Priorities are to the road constructing agency, the engineer and contractor what rationing is to the public, except that road builders have been faced with priorities since July of 1941.

Because the work happens to be roadway construction, doesn't mean that a high priority or any priority is granted. The project must be a defense road improvement before any priority is assigned. The priorities assigned to defense road jobs are not sufficiently high usually to guarantee the construction of work requiring steel. Consequently, we must defer work requiring substantial amounts of steel. In some cases we can substitute other materials. For some time we have been revising our designs to eliminate those hard-to-get materials. Some of our bridges are going to look rather weird.

It should not be overlooked that the use of these substitute materials in the interest of the war effort are not economical as a rule. This type of construction may cost 10 per cent to 50 per cent more than in the business-as-usual days. Considerable additional engineering effort is required in designing with such substitute materials.

WAR PRODUCTION BOARD RULES

Many of you perhaps have heard of the latest order of the War Production Board called L-41 which forbids any construction to start unless it was started before April 9, 1942, unless it is for maintenance and repair, or is for less than $5,000 or has a priority rating and a few more things. However, after having that order just long enough to barely digest it, we received another called L-41-600 which permits State Highway Departments and counties and cities to proceed with roadwork provided no priority assistance is required or the steel and metal products are on hand or ordered before May 8, 1942.

If your project qualifies under this order you may proceed with the project but you must submit a report to

(Continued on page 19)

Legislators Inspect Central Valley Project Units and State Water Plan Sites

MANY of the diversified and intricate water problems of the San Joaquin Valley were seen at first hand by the Joint Legislative Interim Committee on Water Problems during an inspection tour of the valley, May 11 to 17, 1942.

Starting from Stockton the committee made a tour of all of the San Joaquin Valley units of the Central Valley Project and inspected units of the proposed State Water Plan. Noon and evening meetings were held daily so that the water problems of various communities could be presented to the committee by local interests.

Units of the State Water Plan inspected were the proposed Ione dam site on Dry Creek; Pardee reservoir on Mokelumne River; Melones reservoir on the Stanislaus River; Don Pedro reservoir on the Tuolumne River; Exchequer reservoir on the Merced River and Pine Flat reservoir site on the Kings River.

Under the plan of ultimate development of the water resources in California prepared by the State Division of Water Resources and adopted by the State Legislature in 1941, several of the existing dams will be replaced with larger structures providing additional water for irrigation and additional flood control protection.

Features of the Central Valley Project inspected were the proposed route of the Delta-Mendota Canal; Friant Dam, which is more than 99 per cent completed; construction work on the Madera Canal and the proposed line of the 160-mile long Friant-Kern Canal.

In Kings County the committee saw at first hand the damage caused when flood waters topped levees in the Tulare Lake basin and destroyed large acreages of crops that were ready for harvest. A portion of a day was also spent viewing the so-called West Side Lands—a strip of fertile lands approximately 100 miles long and varying in width from 15 to 25 miles in western Kern, Kings and Fresno counties which are now without water. Under the State Water Plan these lands would be served by the Mendota West Side Pumping System which would take an imported supply of water from the Sacramento River at Mendota Pool on the San Joaquin River.

LOCAL MEETINGS HELD

Meetings were held in Stockton, Angels Camp, Modesto, Merced, Fresno, at Friant Dam, Visalia, Hanford, Porterville, and Bakersfield, at each of which local water problems were presented by the local interests and discussed.

At the Bakersfield meeting the committee unanimously passed a resolution urging the Federal Government to complete at the earliest possible time construction of the San Joaquin Valley units of the Central Valley Project, the Antioch steam electric plant and the Shasta-Antioch transmission line.

The committee's final meeting was held in Barstow, on May 17th, when flood control problems on the Mojave River were presented and discussed.

MEMBERS ON THE TOUR

Members of the committee on the tour were Senator B. S. Crittenden, Chairman, Stockton; Senator Chas. H. Deuel, Chico; Senator Ed Fletcher, San Diego; Senator Robert W. Kenny, Los Angeles; Senator R. R. Cunningham, Hanford; Assemblyman Rodney L. Turner, Vice Chairman, Delano; Assemblyman Clyde A. Watson, Orange; Assemblyman Gordon H. Garland, Exeter; Assemblyman Seth Millington, Gridley. Technical assistance was given the committee by State Engineer Edward Hyatt; H. M. Crooker, Resident Engineer, Division of Water Resources, Fresno; R. S. Calland, Division Engineer, U. S. Bureau of Reclamation, Sacramento; R. B. Williams, Construction Engineer, Friant Division, U. S. Bureau of Reclamation; H. W. Boetzkes, Corps of Engineers, U. S. War Department, Sacramento, and Colonel A. M. Barton, Chief Engineer of the State Reclamation Board.

FUNDS FOR CENTRAL VALLEY PROJECT TRANSMISSION LINE AND ANTIOCH STEAM PLANT RESTORED BY SENATE

The Interior Department Supply Bill carrying an appropriation of $39,019,000 for construction work on the Central Valley Project in the fiscal year 1943 will be considered by a conference committee of both houses early this month.

Earlier action by the House Appropriations Committee in eliminating all funds for construction of the Shasta transmission line and the Antioch steam plant was reversed when the Senate approved the recommendation of the Senate Appropriations Committee setting up $3,723,000 for transmission line construction and $200,000 for surveys and plans for the steam plant. In addition the Senate Appropriations Committee added $250,000 to the $1,000,000 ear-marked for the Friant-Kern and Madera canals.

Representatives of the Water Project Authority appeared before both House and Senate committees and vigorously supported appropriations for both the irrigation and power features of the Central Valley Project as set up in the President's Budget.

Following action by the Interior Subcommittee of the House Appropriations Committee eliminating funds for the transmission line and Antioch steam-electric plant, President Roosevelt personally addressed a letter to Senator Carl Hayden, Chairman of the Interior Subcommittee of the Senate Appropriations Committee pointing out the importance of these funds.

Governor Culbert L. Olson actively entered the fight for restoration of the funds as did George Sehlmeyer, Master of the State Grange, who made a trip to Washington to appear before the Senate Appropriations Committee in support of the Central Valley Project appropriations. Many cities and organizations throughout the Central Valley passed resolutions and wired their Washington representatives urging that adequate funds be provided, not only for the irrigation features of the project, but for the transmission line and steam-electric plant at Antioch as well.

Opposition to power features came from Pacific Gas & Electric Company representatives with statements before both Houses.

The Joint Legislative Interim Committee on Water Problems is shown here at Friant Dam, which is nearly complete. From left to right are: Executive Secretary Frank Reed; Senator Fletcher, San Diego; Assemblymen W[illegible]ngton, Gridley, and Watson, Orange; Senators Wynand, Merced, and Kenny, Los Angeles; State Engineer Edward Hyatt; Senator Crittenden, Stockton, Chairman; Mrs. Elizabeth Eyre, Secretary; Assemblyman Turner, Delano, Vice Chairman; Senators Cunningham, Hanford, and Deuel, Chico; R. S. Calland, District Engineer, U. S. Bureau of Reclamation and R. B. W[illegible]ams, Construction Engineer.

Tolls on Carquinez and Antioch Bridges Reduced

(Continued from page [illegible])

considered that even this moderately reduced toll represented an unjustified tribute levied against users of the Carquinez span and determined to start proceedings for its acquisition, as well as that of the Antioch structure, owned by the same company and on which tolls were equally exorbitant.

Early in 1940 Governor Olson requested Director Clark to investigate the feasibility of purchasing these bridges. As a result of Mr. Clark's negotiations with the bridge owners and the bond issue involved the State received $350,000 in cash held by the American Toll Bridge Company and became owner of the spans on September 16, 1940, at a cost of $5,943,000.

Tolls were immediately cut in half. The old rate of 45 cents per car plus 5 cents per passenger was reduced to 30 cents per car with a limit of four passengers. On May 14, 1942, Governor Olson called the Authority into special session in Sacramento and [illegible]

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Carquinez Bridge History

Last month, on May 21st, the Carquinez Bridge entered the sixteenth year of its existence. Since its opening on May 21, 1927, to April 30, 1942, the span had carried a total of 25,969,796 vehicles.

During the 13 years and four months, from 1927, to September 16, 1940, that it was operated under private ownership by the American Toll Bridge Company, Carquinez Bridge carried 18,847,089 vehicles.

Under State ownership, from September 16, 1940, to April 30, 1942, a period of 19 months, Carquinez Bridge had a traffic count of 7,122,707 vehicles.

The average monthly traffic count under private operation was 117,794 vehicles. Under public ownership and the reduction of tolls, the average number of vehicles using the bridge to April 30th, last, was 374,879 vehicles.

Fifteen years ago, more than 75,000 persons gathered at Carquinez Bridge to celebrate its official opening to the motoring public. In Washington, President Calvin Coolidge pressed an electric button which opened the span to the first of 50,000 motorists who crossed it that first day.

It was an auspicious occasion for more than one reason. While the dedication ceremonies were in progress word was flashed that Charles Lindbergh had landed in Paris, completing his transoceanic flight.

Study of Evaporation in South Completed

[illegible]

View of divided road at northerly approach to new and old bridges over Kern River on State Route 142

Four-Lane Divided Highway and Bridge Provided for Traffic North of Bakersfield

By E. T. SCOTT, District Engineer

BAKERSFIELD, Kern County, at the southern end of the San Joaquin Valley, is an important travel center for traffic from Los Angeles and San Francisco via U. S. 99 and from the East via U. S. 466.

From the mines, cattle ranges, and the potato and cotton fields in this region, products are processed or shipped at Bakersfield in annually increasing quantities. However, now, as for years past, oil is a very important product.

The development, distribution and refining of oil necessitates the movement of many loads of pipe, oil well drilling tools, materials for derricks and supplies and tools for foundries, refineries, and repair shops.

An important share of the traffic around the busy center of Bakersfield, flows north over Chester Avenue, Kern River Bridge and through the community of Oildale. Over 14,000 vehicles, in 16 hours pass over this bridge in summer as verified by the last two years traffic counts.

In the past this heavy traffic has trundled along North Chester Avenue over a rough broken pavement, from the north city limits of Bakersfield, around sharp, angular turns at the approaches of the Kern River and thence through the congested streets of Oildale. The old bridge built in 1912 was much too narrow for two-way traffic.

Since December, 1940, three contracts have each contributed to the improvement so urgently needed by this highway traffic.

The first contract covered the construction of new bridges across Kern River and Beardsley Canal.

The new Kern River Bridge is of composite steel and concrete stringer construction. A reinforced concrete deck covers 22 spans of 61 feet and two cantilever end spans of 16 feet. It rests on concrete piers and piles. There is a 5-foot sidewalk and 26 feet of clear roadway width. The cost per square foot of total area was only $4.50.

During construction, traffic used the old bridge with no unusual inconvenience to themselves or the contractor.

The new bridge, of simple but beautiful lines, now comfortably carries the south-bound traffic while the old bridge with realigned and repaved approaches serves the north-bound traveler.

The second and third contracts covered the construction of a four-lane highway, divided, built at an elevated grade to provide proper drainage. They included extensions to Levee Canal Bridge and a pedestrian underpass at the "Standard School" in Oildale. As a whole there is now as-

(Continued on page 18)

Franz R. Sachse Resigns to Join Army Air Corps as a Second Lieutenant

RELINQUISHING a post he had filled so capably as to win the respect and admiration of the executives and employees of all divisions of the Department of Public Works, Franz R. Sachse has resigned as Assistant Director of Public Works to accept a commission as second Lieutenant in the United States Army Air Force.

Appointed Assistant Director on February 6, 1940, Lieutenant Sachse established a record for efficiency which makes the vacancy created by his resignation to enter the armed forces of his country a difficult one for Director of Public Works Frank W. Clark to fill.

Born April 29, 1910, in San Francisco, Lieutenant Sachse was educated in the grammar schools of Berkeley, Oakland and San Anselmo. He attended high school in Los Angeles and Pasadena and then entered Stanford, graduating with an A.B. degree in 1931. He received an LL.B. degree from the same university in 1933 and was admitted to the Bar in 1934. He engaged in the private practice of law in Los Angeles from 1934 to the date of his appointment as Assistant Director of Public Works.

Lieutenant Sachse was tendered a farewell dinner at the Del Paso

FRANZ R. SACHSE

Country Club by his associates in the Department of Public Works on the eve of his departure to report for duty.

Mrs. Sachse and children will remain in Sacramento until the end of this school term and will then go to the Sachse family ranch at Fallbrook, San Diego County.

Visalia Highway Completed

(Continued from page 10)

using a very direct route. This avoids further congestion of the busy Main Street and develops an ideal truck road from which tourist and business traffic can easily turn off into any section of the city, while in a similar way, the city traffic feeds into the trunk road. The principle of a trunk road serving both city and tourist traffic, was never more nicely demonstrated.

At the official opening ceremony, Mayor Pierce Gannon spoke briefly and introduced Iener W. Nielsen, member of the State Highway Commission, who after complimenting the city and the contractor upon their accomplishment, accepted the work on behalf of the State Division of Highways. Mrs. George France, wife of the contractor, and a resident of Visalia, cut the ribbon, thus formally opening the road to traffic.

The project, completed May 15th, and costing approximately $65,500 was financed in part, from Visalia's share of gas tax moneys, divided among cities as "quarter cent funds," in proportion to the population of each community. The remainder of the cost was borne by the State Division of Highways as their share of the cooperative project.

George France of Visalia, was the contractor and City Engineer N. A. Huth represented the municipality. P. A. Boulton was Acting Resident Engineer for the State. The State and city cooperated as needed.

Four-Lane Divided Highway and Bridge

(Continued from page 16)

sured a measure of safety and convenience to traffic, long needed and fervently desired.

Central islands, of variable width and design in accordance with needs, separate the two roadways. Side slopes are generally 5 per cent. These and the gutters are surfaced with 2 inches of road-mix surface treatment. Easy access is afforded to commercial establishments along the streets.

From Levee Canal northerly the paving consisted of asphalt concrete base, leveling course and surface, separated by islands or dividing areas guarded by raised bars and double stripes. Each paved roadway accommodated two traffic lanes.

From the Levee Canal southerly the paving on each side included a base of rolled, 3-sack concrete, while asphalt concrete was used to surface the whole paved area of the two roadways, on either side of dirt filled separating islands outlined by concrete curbs.

On this last contract the rolled concrete base proved very satisfactory. Following is a brief description of the methods used:

A coarsely graded 1½-inch maximum sized aggregate was obtained by blending accurately from two bins about 43 per cent of material passing No. 4 sieve with 57 per cent of material retained on No. 4. The water added at the central mixing plant was controlled through frequent tests of moisture in the untreated material. The resultant total water varied from 6½ to 7 per cent and was maintained slightly below the amount which would cause quaking or displacement under the roller.

The desired moisture content is indicated in the laboratory, when a slight amount of free water appears on the specimen, when subjected to standard moulding pressure. While this moisture content appears high in comparison to that used in 6-sack concrete, it is actually less than is used in the driest of ordinary 3-sack concrete mixes.

The mixed concrete was deposited from trucks, through a spreader box; then spread to a uniform depth over the entire width of the strip, by means

(Continued on page 20)

Highway Picture As Changed by Imperative War-time Conditions

(Continued from page [illegible])

the Public Roads Administration through the State Highway Department, on or before the tenth of the next month. This report must show the estimated materials you will use and be prepared on form PR-16. This form may be obtained from the Public Roads Administration or the State Highway Department.

If you do not qualify under L-41 or L-41-600 or you need priority assistance you may request a "Begin Construction Permit" or a priority rating from the Public Roads Administration through the State Highway Department. The application required is practically the same in each case.

ONLY ESSENTIAL WORK

Instructions on preparation may be obtained from the Public Roads Administration or the District Engineers of the State Highway Department. The application should be transmitted to the Division of Highways District Engineers. However, as will be mentioned later, there is little use applying for priority ratings and probably "Begin Construction Permits" unless the work is a required defense road project or absolutely essential to the civilian welfare. Furthermore you will need to revise your construction designs to eliminate critical material unless such materials are indispensible.

It may be seen from these requirements that the Public Roads Administration is endeavoring to help our roadbuilding agencies wherever possible. This seems proper as the P. R. A. is the [illegible] representative of the four [illegible] roadbuilding agencies of the [illegible] the supervisors, the State Highway Department and the Federal Public Roads Administration.

While on the subject of W. P. B. orders there is [illegible] an amendment to preference order M-21. This new amendment says you can't get any unfabricated steel products without [illegible] except for maintenance and repair. Neither can you today obtain priority ratings for delivery of road building equipment.

Today finds lumber frozen at the mills and after June 1st a permit will be required in order to obtain railroad tank car shipments. Amendment No. 2 to preference rating order P-19e states in effect that road construction priority ratings can not be used to obtain form lumber and falsework, drill steel and tools. This order as now written will drastically affect bridge and culvert construction whether on defense roads or not.

There are a lot more W. P. B. orders that affect road work in general, all of which emphasizes the fact that the material picture will not permit anything but defense highway construction and maintenance. Even maintenance will be hampered because delivery of required equipment can not be obtained.

One of the other factors mentioned as affecting the highway picture today is the access road program. As already mentioned, this program is under way. It is expected that more of this work will be financed by the Federal Government. This work has practically occupied our entire engineering forces for some time. Necessarily then we have had to postpone preparation of plans on other regular budgeted work. It has also made necessary certain fiscal adjustment because State highway funds were required in certain cases for right of way, engineering and certain temporary patching costs.

Military traffic in the vicinity of defense establishments is causing considerable damage to our highways. It is estimated that this heavy traffic has damaged [illegible] to the extent of about $[illegible]. Furthermore a large part of this heavy traffic has occurred on roads that are not part of the so-called Federal designated Defense Highway System. Also, if we are not able to proceed with construction because of war requirements, further heavy maintenance will be required.

[illegible]

The defense road [illegible] includes the access roads and the strategic network. The strategic network is the main network designated by the Federal Government over which troop movements [illegible]. This network is secondary in importance to the access roads.

The strategic network improvements are financed by State funds or by matching [illegible] with Federal funds. Before Federal funds can be expended the Secretary of War or Navy must certify that the project is a defense [illegible] [illegible] it is necessary to show that the strategic road [illegible]

[illegible]

Road Builders Pledge All-out Co-operation

All-out co-operation with America's victory effort was pledged by the American Road Builders' Association at its recent Defense Highway Congress in Memphis, Tenn. Another resolution reaffirmed the association's stand in support of the contract system as the best method for road construction. Alabama Highway Director Chris J. Sherlock was formally installed as ARBA president at the Victory Banquet held at the Peabody hotel.

Retiring President Hal G. Sours, Ohio director of highways, addressed the banquet, stressing the need for a post-war road program. The association presented Mr. Sours with a U. S. defense bond in recognition of his services during his two years as president.

Guest speaker was John L. Rogers, director, division of motor transport, Office of Defense Transportation, who discussed the role of highway transportation in the national emergency. Tennessee Congressman Clifford Davis served as toastmaster and introduced distinguished banquet guests.

Indispensability of motor transportation to defense was stressed in the address of G. Donald Kennedy, Michigan State Highway Commissioner and American Association of State Highway Officials president.

Highway Bids And Awards for May 1942

ALAMEDA AND CONTRA COSTA COUNTIES—Between El Cerrito Hill Overhead in Albany and the intersection of Cutting Blvd. and 7th Street in Richmond, about 1.9 miles, the portion on Potrero and Hermann Avenues to be graded and the entire project to be paved with asphalt concrete. District IV. Union Paving Co., San Francisco, $251,745; A. G. Raisch, San Francisco, $257,659; Macco Construction Co., Clearwater, $276,557; Chas. L. Harney, San Francisco, $436,392; Marshall S. Hanrahan, Redwood City, 176,061. Contract awarded to Piazza and Huntley, San Jose, $237,177.

CONTRA COSTA COUNTY—Between San Pablo Creek bridge and Oleum, about 7.0 miles to be widened with crusher run base, Portland cement concrete and asphalt concrete. District IV, Route 14, Section A Pin, Her B. Contract awarded to Lee J. Immel, Berkeley, $119,375.

CONTRA COSTA COUNTY—City of Richmond on 14th & 15th Sts., about 1.2 miles to be graded and paved with Portland cement concrete, asphalt concrete and crusher run base. District IV. Peter Sorensen, Redwood City, $99,757; Lee J. Immel, Berkeley, $103,625. Contract awarded to Heafey Moore Co., Oakland, $99,101.

MENDOCINO AND LAKE COUNTIES—At various locations about 8.3 miles in length existing gravel base to be widened, cushion blanket of gravel base to be placed and drainage structures to be constructed. District I, Routes 15, 49, 89. E. A. Forde, San Anselmo, $74,207; Beerman & Jones, Sonora, $77,089. Contract awarded to Harold Smith, St. Helena, $64,601.

MONTEREY COUNTY—Between Quinado Canyon and King City, about 8.5 miles to be graded and surfaced with cement treated base and plant mixed surfacing, and a timber bridge to be constructed over Pine Creek. District V. United Concrete Pipe Corporation & A. S. Vinnell Co., Los Angeles, $556,890; Earl W. Heple and Parish Bros., San Jose, $581,161. Contract awarded to Basich Bros., Torrance, $495,755.

ORANGE COUNTY—Between Lincoln Avenue and Orangethorpe Avenue about 2.0 miles to be graded and surfaced with asphalt concrete on cement treated base. District VII, Route 171, Section B. Griffith Co., Los Angeles, $128,821; Vido Kovacevich, South Gate, $141,845. Contract awarded to Oswald Bros., Los Angeles, $111,950.

SACRAMENTO COUNTY—Bridge across Sacramento River at Isleton and a bridge across Steamboat Slough about five and seven-tenths miles north of Walnut Grove, to be redecked. District III, Route 11, Sections D,E. Holdener Construction Co., Sacramento, $13,101; Lord and Bishop, Sacramento, $13,340; C. C. Gildersleeve, Colusa, $14,498. Contract awarded to M. A. Jenkins, Sacramento, $12,342.

SACRAMENTO COUNTY—Between Mills and Mather Field about 1.5 miles to be graded and surfaced with plant mixed surfacing on gravel base. District III. Hemstreet and Bell, Marysville, $63,752; A. M. Bell Sons, Berkeley, $62,705. Contract awarded to A. Teichert & Son, Inc., Sacramento, $60,816.

SAN DIEGO COUNTY—On Pacific Highway between Torrey Pines and Del Mar, about 3.6 miles to be widened and surfaced with Portland cement concrete and asphalt concrete pavements. District XI, Route 2, Section S.D.A. Griffith Co., Los Angeles, $240,333; R. E. Hazard & Sons, San Diego, $253,510; V. R. Dennis Construction Co., San Diego, $259,587; Daley Corp., San Diego, $264,565. Contract awarded to Oswald Bros., Los Angeles, $231,395.

SOLANO COUNTY—In the city of Vallejo, various city streets and extensions, a total length of about 0.7 mile, to be surfaced with plant mixed surfacing on crusher run base. District X. A. J. Clausen, Berkeley, $19,849; A. G. Raisch, San Francisco, $20,360. Contract awarded to E. A. Forde, San Anselmo, $19,11[illegible].

Four-Lane Divided Highway and Bridge

(Continued from page 18)

of a motor grader and compacted by first wheel rolling with a very heavy truck, followed by double rolling with a 13-ton tandem roller.

It was then bladed to remove irregularities and double rolled by the tandem. After lightly sprinkling, when needed, the truck rolled it again to knit or seal the surface, in order that the emulsion cure, applied by hand spray immediately thereafter, would easily cover and prevent drying and scuffing of the surface.

The heavy truck loaded with a large water filled tank gave a total load of 37,000 lbs. or a load of 24,600 lbs. on the four rear wheels.

This extreme load, applied through pneumatic tires and supplemented by the smooth roller, while unusual, and not specified, yet proved an ideal treatment for the material, which depends, for density and strength upon the prompt application of a heavy roller, with pneumatic tires preferred for the first rolling. Cores, taken from the completed base showed compressive strengths, averaging over 1800 pounds per square inch.

The project, as a whole, included the following contracts, with their associated personnel, as indicated below:

Contract of A. Teichert and Son, contractor, and A. K. Gilbert, resident engineer. Approximate cost, $192,200.

Contract of Griffith Company with D. G. Evans, resident engineer and W. M. Nett, assistant in charge. Approximate cost, $95,808.

Contract of Griffith Company with D. G. Evans, resident engineer and W. M. Nett, assistant in charge. Approximate cost, $66,870.

A SHEET OF IRON a hundred thousandth of a millimeter thick is as transparent as glass.

Speed Restrictions and Group Riding

(Continued from page 3)

At the Los Angeles meeting Vickrey and Joseph Mattson, representative of the Office of Defense Transportation, instructed the field workers in the fundamental principles of the Eastman Program.

At the conclusion of the meeting, Secretary Vickrey announced that for the purposes of administration, the State would be divided into six areas or districts with headquarters in San Francisco, Los Angeles, San Diego, San Bernardino, Fresno, and Sacramento. Offices of the Division of Highways will be utilized in these respective cities as administrative headquarters for the committee.

The areas were arranged geographically to follow the lines of highway patrol districts so that patrol district inspectors will be in a position to carry on the program and to utilize the men in their respective districts for the work. The district traffic engineer in each area will serve as the contact and coordinating official. The field workers were instructed to return to their respective districts, make a survey of existing conditions, and proceed immediately with plans for carrying out the program.

Great stress was also placed at all of the sessions on the fact that the plan is an attempt to solve a very serious problem by democratic processes. Several speakers, among them Carter, the Chairman, State Engineer Purcell and Railroad Commissioner Richard Sachse, gave the warning that should voluntary measures fail, the Federal Government is prepared to take more drastic steps. Several speakers quoted statistics produced by the Office of Price Administration and from other sources, proving irrefutably that there will be no rubber whatever for private passenger cars for a long time and that the entire supply will be needed for military and essential civilian uses.

Within the next few weeks several district meetings are planned throughout the State for a further explanation of the plan. Meanwhile, a Statewide campaign of publicity will be carried on to acquaint the public with the necessity of conserving their cars and their tires.

State of California

CULBERT L. OLSON, Governor

Department of Public Works

Headquarters Public Works Building, Twelfth and N Streets Sacramento

FRANK W. CLARK, Director of Public Works

FRANZ R. SACHSE, Assistant Director

MORGAN KEATON, Deputy Director

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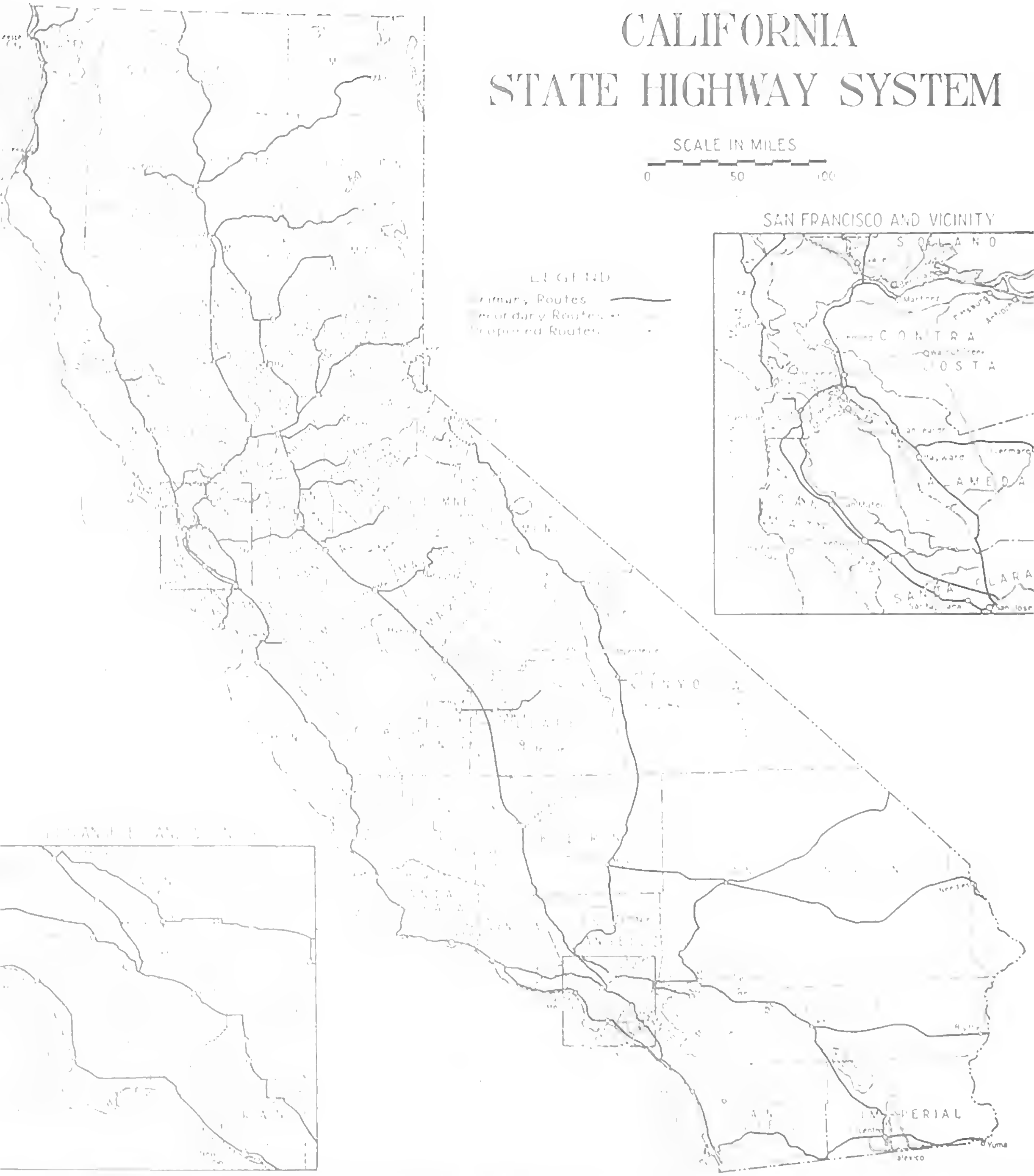

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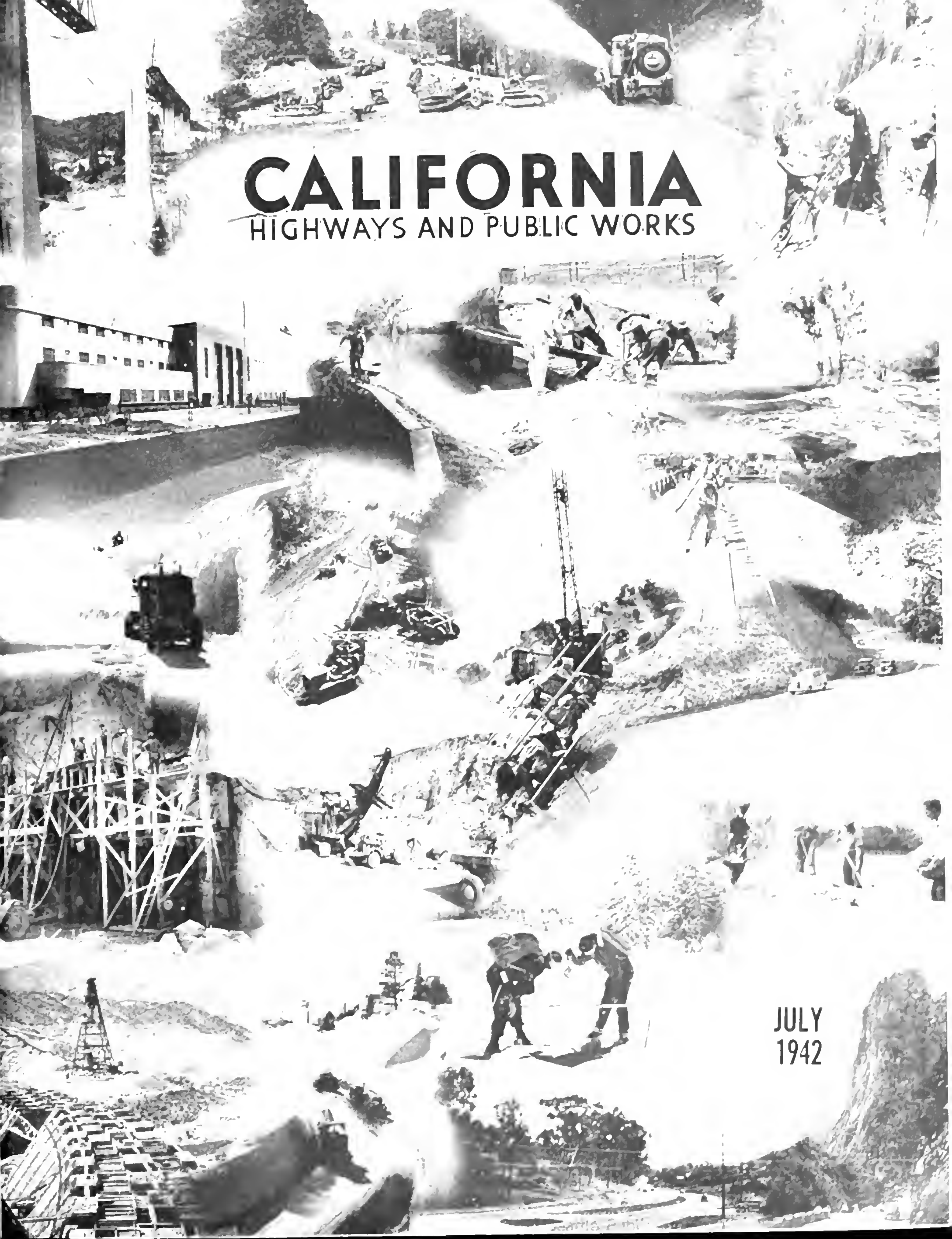

JULY
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CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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FRANK W. CLARK, Director C. H. PURCELL, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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Vol. 20 JULY, 1942 No. 7

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Congress Votes $39,019,000 For Central Valley Power Project and Irrigation Features

VICTORY has been achieved by the California State administration led by Governor Culbert L. Olson in its long and at times discouraging fight in Congress to have included in the Interior Department Appropriation Bill for 1943 fund allocations for transmission lines, canals and a steam plant at Antioch as integral units of the Central Valley Project.

On June 29th, the House of Representatives approved Senate amendments to the bill adding $4,178,250 for these purposes and the following day the Senate passed and sent to the President the measure which appropriates a total of $39,019,000 for expenditure on the Central Valley Project for the next fiscal year.

The Congressional action was hailed by Frank W. Clark, Director of Public Works and chairman of the California Water Project Authority as another victory for the people of this State over opposing power interests. Approval by the House of Senate amendments provides initial appropriations of $3,723,000 for transmission lines required if Shasta Dam power is to be distributed under public ownership; $200,000 for the proposed steam plant at Antioch and an additional $250,000 for the Friant-Kern and Madera canals.

Governor Olson made a personal appeal to President Roosevelt for these items. The House passed the amended bill by a vote of 192 to 141 after Majority Leader McCormack of Massachusetts told the members the President favored the appropriations as necessary for the war program. State Engineer Edward Hyatt and his assistant, Raymond Matthew, representing the Water Project Authority, and Northcutt Ely, Washington representative of the Authority, had much to do with the successful outcome of the fight.

The Interior Department Supply Bill as prepared by the Bureau of the Budget carried a total appropriation of $48,769,000 for construction work on the Central Valley Project for the fiscal year 1943. This amount was reduced to $34,840,750 by the Subcommittee of the House of Representatives' Appropriations Committee and the committee report was approved by the House.

Central Valley Project Monies Appropriated

The Interior Department Appropriation Bill for 1943, as approved by Congress, carries an appropriation of $39,019,000 for continuation of construction of the Central Valley Project, the main items of which according to the budget estimate as modified by House and Senate Committees are as follows:

Shasta Dam and Power Plant	$24,783,000
Keswick Dam and Power Plant	6,000,000
Transmission Lines	3,723,000
Steam Plant	200,000
Friant Dam	1,625,000
Friant-Kern and Madera Canals	1,260,000
Contra Costa Canal	1,260,000
Miscellaneous	100,000

The House committee report not only eliminated an estimate of $5,000,000 for installation of a steam-electric power plant near Antioch, California, and an estimate of $7,000,000 for continuing construction of transmission lines from the Shasta and Keswick hydroelectric plants to Antioch, but also had the effect of repealing appropriations amounting to $3,723,000 previously made for the construction of the transmission lines. At the same time the House increased the item of $200,000 for the Contra Costa Canal to $1,000,000 and added $1,000,000 for construction of the Friant-Kern Canal.

In commenting on this action the Senate Appropriations Committee report declared:

"This action by the House does not appear to be justified by the testimony presented to the committee and can not be construed in any other way than as the adoption of a policy which contemplates that all power, both firm and fluctuating, generated at Shasta and Keswick shall be sold when produced to but one customer, which is the Pacific Gas and Electric Company. A majority of this committee believes that this is an unsound public policy because:

"1 The acts of Congress authorizing the construction of Central Valley Project, the total cost of which is now estimated as $264,990,000, contemplates the return to the Treasury of the greater part of its costs through sales of power:

"2 To obtain maximum revenues from that source the Bureau of Reclamation should be in a position to deliver the power to the best obtainable market and to more than one customer. When transmitted to such point or points, said bureau should be able to make such power firm by the construction of an auxiliary steam plant.

"The committee recognizes that the Congressional policy respecting the Central Valley Project was adopted during a period of profound peace and that our country is now engaged in a desperate struggle for its existence. Everything must yield to winning the war, but any action taken to insure victory should not be of a character which will prevent a prompt return to the power plan heretofore established for the Central Valley Project."

The Senate Committee then recommended an appropriation of $200,000

(continued on page [illegible])

Survey Party Adapts Radio Device

By R. S. BADGER, District Construction Engineer

Recorder and chainman in foreground with levelman in distance

TRAFFIC noises have become a serious interference with efficiency of survey operations conducted beside arterial highways and may even threaten the accuracy of data called out to the recording engineer amidst a confusion of sounds caused by speeding vehicles.

In cross-section work adjacent to a highway and under average conditions, the sections are taken at distances as great as 250 feet each way from the instrumentman. The bench marks, set on the earlier surveys, were placed under conditions that permitted two "setups" between bench marks which were placed 1,000 feet apart.

The noise of present day traffic now effectively drowns out the voice of the levelman in calling to a recorder when the latter is not more than 125 feet away, and similarly in the case of data, called back to the chainman, it is difficult for the recorder to hear the figures accurately.

Inefficiency and uncertainty result, rendering it necessary to make three "setups" between 1,000 foot bench marks, where formerly two were needed. There is still much difficulty experienced in readily hearing all data called out and consequent delays.

LISTENING AID USED

Proving that necessity is truly the mother of invention, a survey party of Highway District VI has successfully overcome these difficulties. A device has been used to permit the recorder to keep up with the chainman and rodmen at all times, and still hear without difficulty, the rod readings called by the levelman.

The device is a "listening aid," commonly used by radio service men to aid them in detecting noises in radios. It consists of two radio tubes, some small A and B batteries and a universal microphone set in a small box together with about 300 lineal feet of rubber covered wire.

When in use the "listening aid" is suspended from any light standard or tripod near the levelman, so that he may speak into it. From this box the weather-proofed wire leads along the surface of the ground and connects with the earphone headpiece, worn by the recorder. To take up the drag of the wire behind him, it is lightly clamped to his belt with no resultant pull of the wire, reaching from his belt to the earphone.

RECORDER HEARS PLAINLY

As he keeps up with the work of the chainman, so that he can easily hear the data called out by him, he can also plainly hear the rod reading which the levelman calls into the microphone at the other end of the wire.

There is a distinct advantage in the recorder being able to see the operations of the rodman and chainman, but the principal gain lies in

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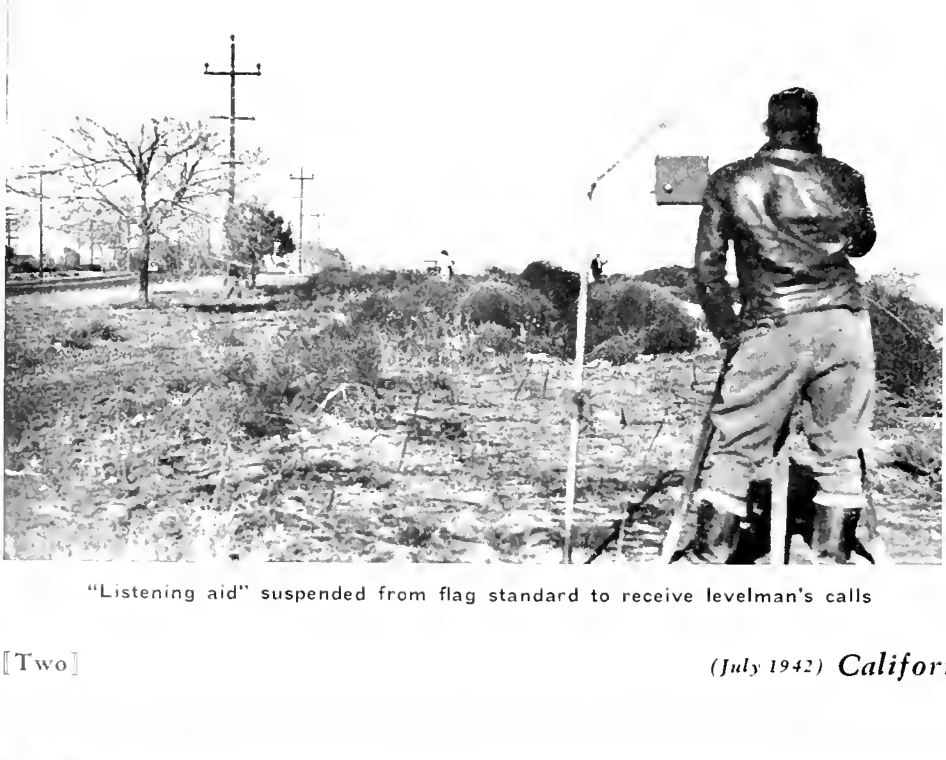

"Listening aid" suspended from flag standard to receive levelman's calls

Snow removal crews meet on Sonora Summit. District IX snowplow in foreground; District X plow in distance

Dynamite and Snowplows Conquer Frozen Stretches of Sonora Pass

By C. E. BOVEY, District Maintenance Engineer

ALTHOUGH midsummer weather now prevails throughout the larger part of California, with old Sol pouring out radiant heat in all his glory, winter lingers on in the high Sierra Nevada in the vicinity of Sonora, Ebbetts and Carson passes. The fields in the valleys have shed their spring-green cloak for one of summer browns and yellows, but in the high regions the green cover is barely discernible on those portions of the mountain slopes not covered with a deep mantle of snow. There, Spring is just beginning. Temperatures seldom reach 60 degrees during the day and drop to freezing, or near-freezing, during the night.

Each year, beginning early in May, the District X office is beset with letters, telegrams and telephone calls inquiring as to when the mountain highways will be open to traffic. At Silver Lake on the Carson Pass Highway, Route 34, at Lake Alpine on the Ebbetts Pass Highway, Route 24, and at Brightman Flat and Kennedy Meadow on the Sonora Pass Highway, Route 13, are many summer homes, camp sites of various organizations, and numerous resorts which do a thriving business during the vacation season. Home owners, organization officials, resort owners, vacationists, and last but not least, the followers of Isaac Walton, all eagerly await the first opportunity to visit their favorite mountain haunts which they have not seen since the first heavy snow storms of the preceding fall.

Normally, snow removal operations are so scheduled that the roads are open to these locations by Memorial Day, May 30th. When the snow pack is near normal, this is no small chore, particularly on the Carson Pass Highway where the snow lies deeply drifted for mile after mile. Woe unto the Maintenance Department of District X if the highways are not open to these places on that day.

The members of the maintenance crews eagerly await the word to start plowing operations even though they know they will work long, hard hours, double shifting whenever necessary to meet the planned schedule. The hard-packed, deeply drifted snow removed in the Spring is entirely different from the soft, flaky snow encountered during the regular winter plowing.

In past years, plowing was resumed immediately after Memorial Day and continued until the highways were open throughout their lengths. Cold weather at the higher elevations retarded the melting of the snow and further increased the difficulty of plowing operations. The presence of ice layers made it necessary to do considerable blasting before the plows could make efficient headway. Often the snow pack averaged from four to

Highways and Public Works

Pass Highway, Route 24, as compared with 22 in 1941.

The Ebbetts Pass was opened on June 26th and Carson Pass on June 28th, two and three weeks, respectively, later than the opening dates of last year, notwithstanding the fact that plowing operations were suspended for approximately ten days after reaching Silver Lake and Lake Alpine. If operations had been continuous, an earlier opening would have resulted. Delayed starting does not result in a correspondingly later opening as considerably faster progress can be made. The cost of opening Ebbetts Pass Highway was only 12 per cent of that of last year, and Carson Pass, only 24 per cent. Some saving was also effected in the maintenance of the traveled way on both routes. The later opening permitted considerable drying of the roadbed, with the result that less damage was caused to the traveled way. Thus the delayed plowing has effected a real saving.

The highway over the Sonora Pass was opened to traffic on June 19th. This very early opening, considerably in advance of that of the other two passes, was made possible by Paramount Pictures, Incorporated, which company paid for the entire cost of opening the Sonora Pass Highway to within 1.8 miles of the summit.

Driven out by the heavy snow storms of last Fall, Paramount officials were anxious to return with a cast and crew of more than 200 persons to resume shooting the snow scenes required in the filming of Ernest Hemingway's "For Whom the Bell Tolls," a story having as a background the recent Spanish civil war. Paramount scouts, after having made an exhaustive search covering all of the Western States, found that the famous Blue Canyon on the west side of the Sonora Pass was the ideal spot for the filming of this picture.

The camera crew followed the Snogo up the steep mountain grade shooting scenes for the picture while the snow was still flying from the rotary plow. During the early morning hours the members of the cast were more than glad that the script required the wearing of fur-lined jackets and ear muffs.

Sonora Pass, gateway to the famous pioneer mining district of Bodie and vicinity, is traversed by State Highway Route 13, the limits of which are at Route 4 at Salida and Route 23 at

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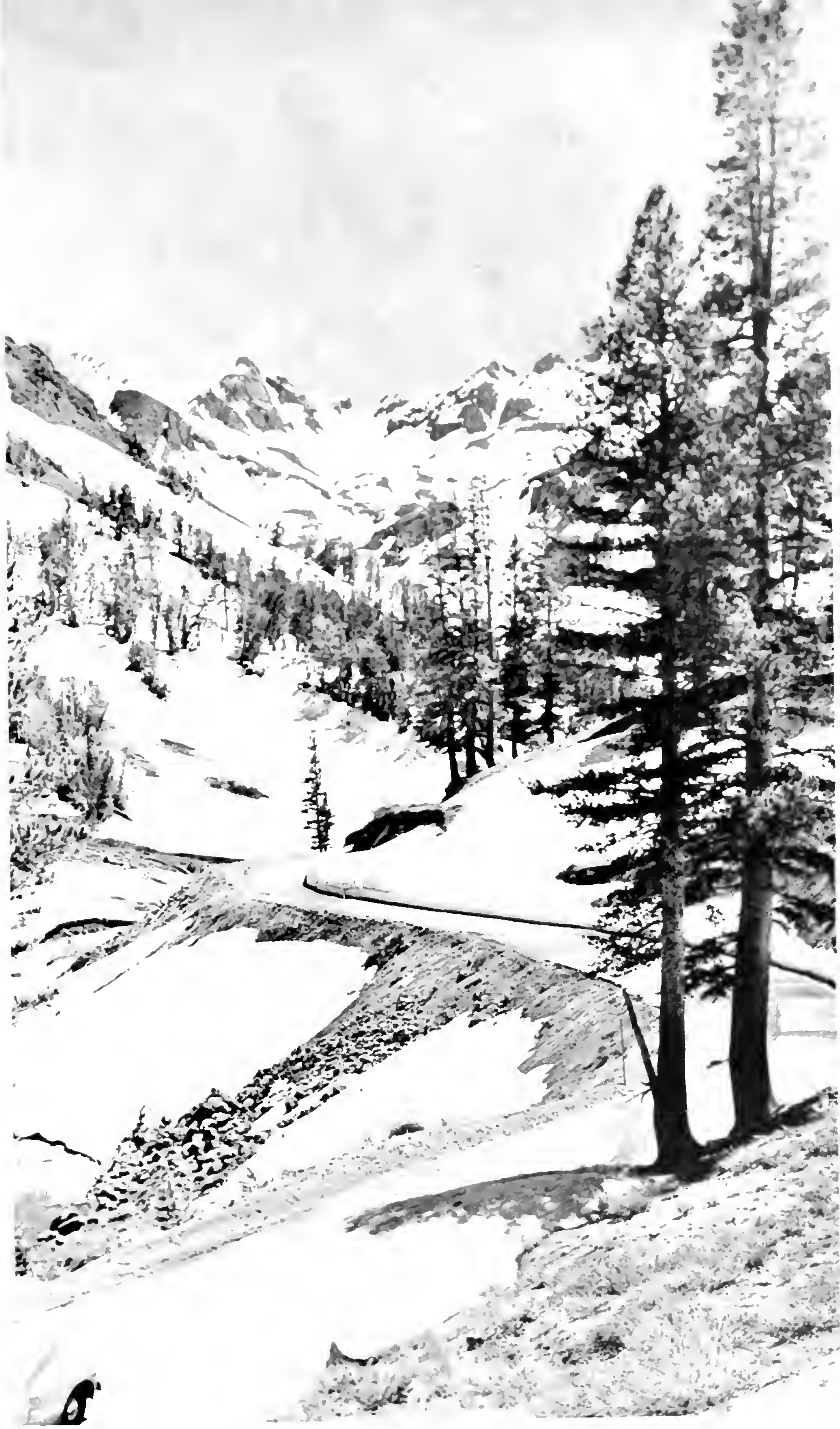


AFTER

This photograph shows Sonora highway after snowplow had passed

Snow was packed so hard on Sonora Pass Highway that it had to be dynamited before plows could work. Upper—Blowing Pack. Lower—Plow makes headway

One-in-a-Million Wrong-Way Driver Compels Added Barriers on Freeway

By N. W. REESE, District Traffic Engineer

WHEN California's first Freeway, the Arroyo Seco Parkway, was constructed between Los Angeles and Pasadena, little precedent existed for the design of such highways. It is true that two such highways had been built in the East, but these had not been in operation long enough to determine the practicability of some features of their design.

The engineers who designed Arroyo Seco Parkway tried to incorporate every known safety feature to provide for the average driver. However, topographic and right of way considerations restricted the full development of design which might otherwise have been possible in more open territory.

The restrictions mentioned above precluded the use of a full clover-leaf design for interchange of local and through traffic at the few intersections on the Freeway. Instead, access facilities to the main cross streets were provided by "On" and "Off" ramps for traffic entering or leaving the Freeway. Most of these ramps were constructed 24 feet in width.

Regardless of all precautions taken, however, to render accidents impossible, there have been a few motorists who have attempted to enter the Freeway on these "Off" ramps, thus being forced to make a very difficult turn in order to proceed in the normal direction of traffic, or in a few instances, have proceeded in the wrong direction and thus, sooner or later, have come into conflict with some other motorist.

While the number of these offending drivers has been very small, the consequences of such a movement are very likely to prove serious. In one case, a collision resulted in a fatality.

ONE-IN-A-MILLION RATE

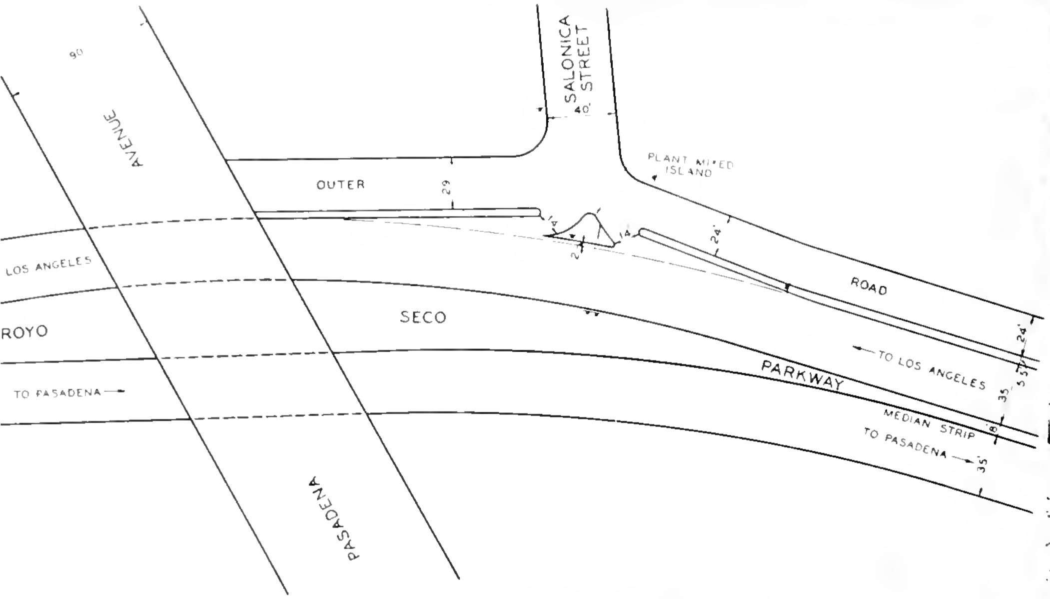
While the collision rate on the Arroyo Seco Parkway is not high when measured on the basis of accidents per million vehicle miles, the unit used as a State-wide yardstick, the accidents which have occurred there have received wide publicity.

Our figures show that not more than one motorist in one million who

(Continued on page 20)

Traffic hazards created by drivers entering Arroyo Seco Parkway by way of an exit ramp will be greatly reduced by treatment pictured above

Upper—Exit ramps protected by long raised islands to prevent left turn onto Parkway. Center right—Construction work. Lower left—Los Angeles bound connection at Salonica Street. Lower right—"No Left Turn" marker reminds careless drivers



New Traffic Signal Dispatcher Possessed of Human Abilities

By A. E. SIMMONS, Assistant District Traffic Engineer

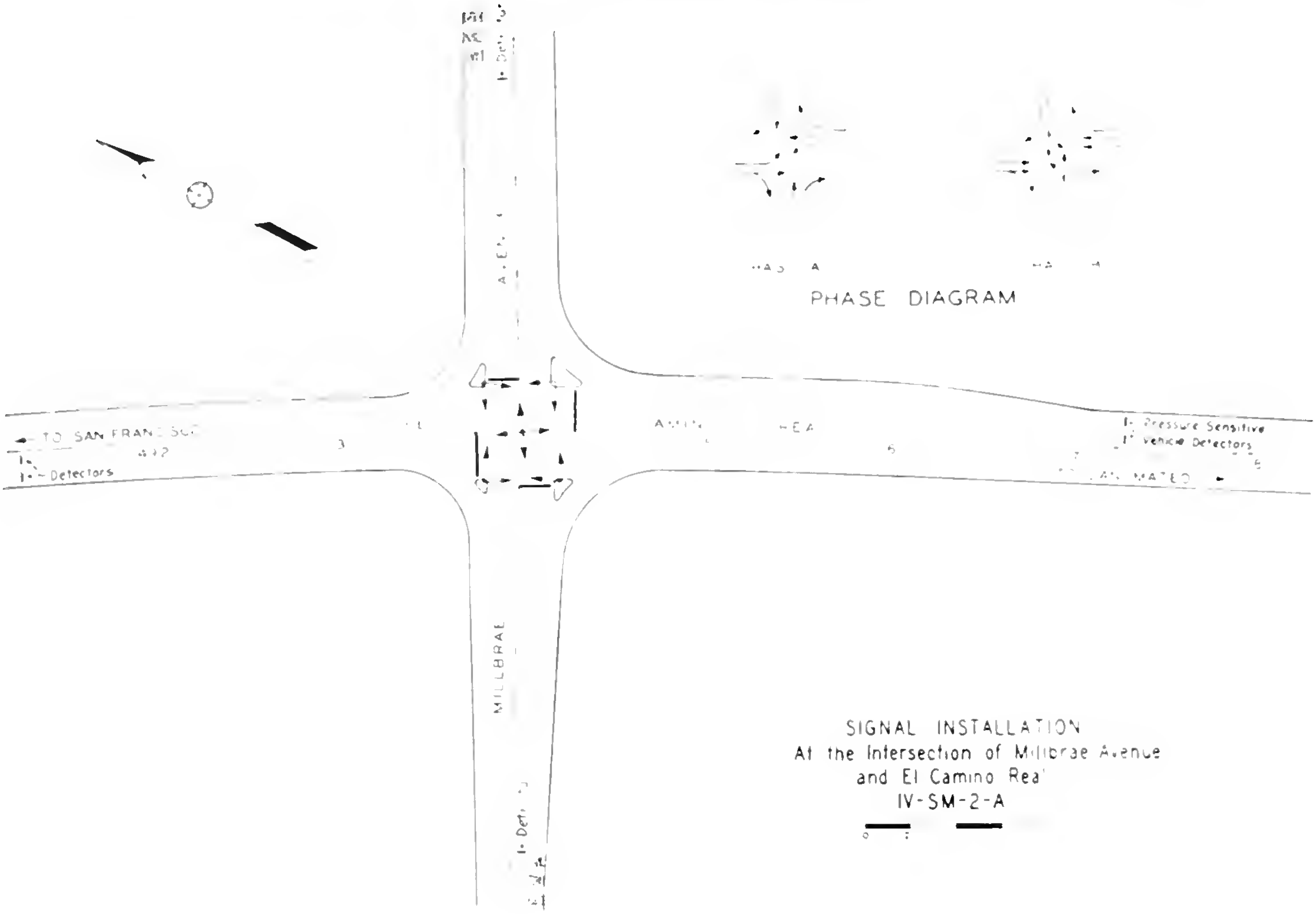
A TRAFFIC signal dispatcher that can add, subtract, remember and practically think, is the Traffic Engineer's answer to the problem of dispatching vehicles through the modern congested intersection.

Formerly a fixed time type of controller or dispatcher has been used to control traffic under these conditions, one which changes its signals in a predetermined fixed total time cycle and the divisions thereof. It is readily apparent that the fixed time cycle is not entirely satisfactory for constantly varying traffic demands. As is frequently the case with fixed time signals, the heavy traffic flow is stopped when little or no traffic is crossing from the opposing lanes.

Various types of control devices have been developed to alter the cycle lengths to predetermined patterns in an attempt to fit the traffic demands, but at the best, this method is just a guess as to the needs of the various arteries.

An improvement over the fixed time control has been available and in use for some time. This controller is ac-

Northbound traffic on U. S. 101 proceeding under regulation of new traffic signal dispatcher in Millbrae



tuated by vehicles crossing detectors placed in the traffic lanes approaching the intersection. The controller is so designed that continuous traffic on an artery will retain the right of way up to a certain maximum period, even with a demand from the cross street. Without any cross street demand the artery would have a continuous right of way until an actuation was received from the cross street traffic. The cross street would then hold the right of way as long as there was a continuous traffic flow up to a certain maximum time, or until a demand was made by the artery.

This was a step in the right direction, but unfortunately the controller was so designed that only during the green period were the vehicles crossing the detectors able to adjust the right of way period. If one or a dozen vehicles cross the detector during the red period, the same amount of time was allotted during the following green period. In certain instances this arrangement was not entirely satisfactory, and demonstrated the need for a type of controller that would function when actuated by vehicles crossing the detector during the red period.

FLEXIBLE DISPATCHER

The manufacturers being aware of the limitations of the above type controller, made a thorough study of the situation. A dispatcher that is really flexible has been developed. This new type dispatcher not only provides for adjustment of the signal intervals by vehicles approaching on the green and red intervals, but in addition, provision is made for adjustments of signal intervals by the number of vehicles, the density of vehicles, and the waiting time of vehicles at the intersection. As a matter of fact, there are 11 separate adjustments on each of the two signal phases. The dispatcher actually has the ability to memorize.

The dispatcher has a *memory* built into it. For instance, if a vehicle approaching the intersection passes over the detector at the instant the green light changed to amber, the dispatcher will clear all the traffic on the opposing artery. Then, remembering that there was a car on the other artery that did not clear the intersection on the previous period, the dispatcher will (actually) assign the right of way to the waiting vehicle without any additional actuation.

INTRICATE PROCESS

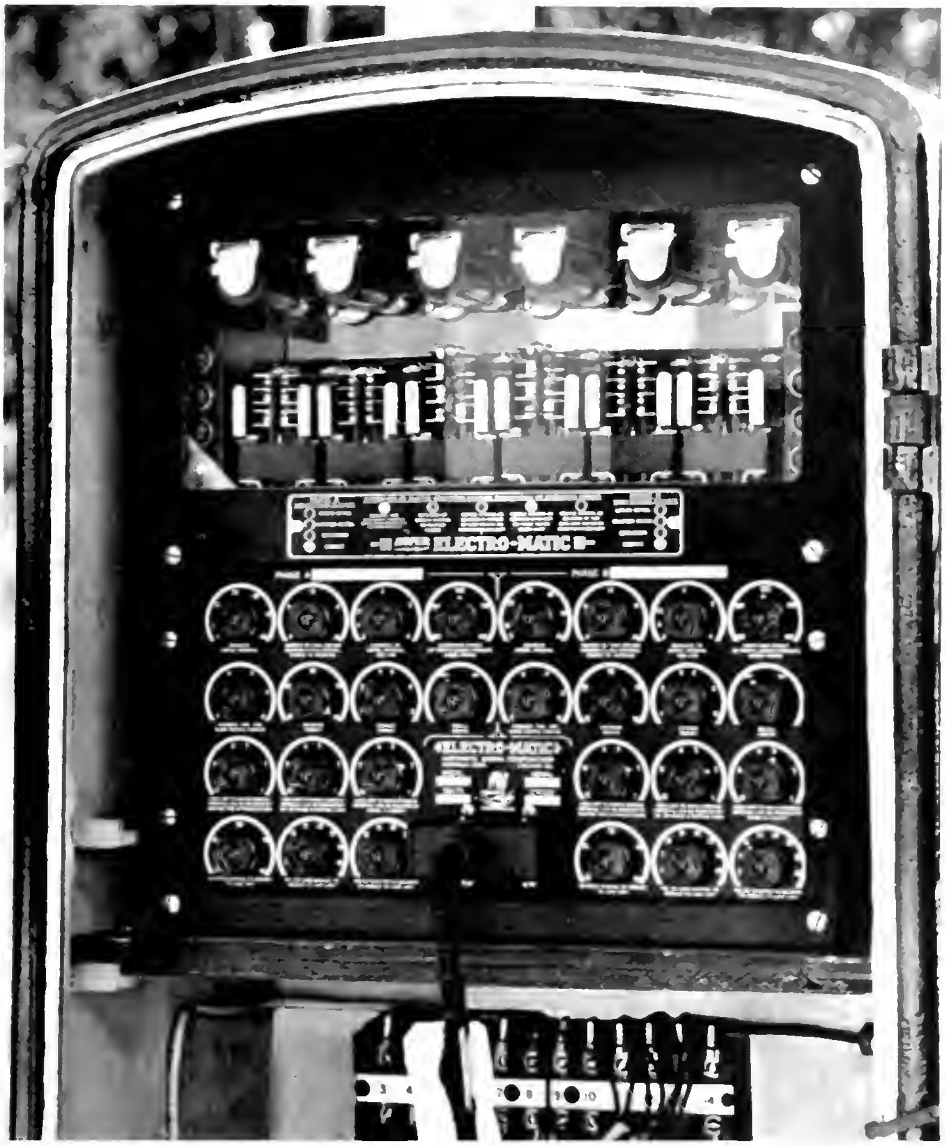
Model 1022 is a two phase full-actuated dispatcher for the operation of traffic signals on a plan which automatically adjusts itself to, and takes fullest advantage of, the instantaneous variations in traffic volume, relative densities of traffic on the two phases and the total elapsed time between actuation and assignment of the right of way.

Account is taken of every vehicle approaching the intersection, whether it be on the green period or the red period and all of the timing intervals of the dispatcher are affected and modified accordingly. The dispatcher is so designed that it automatically balances the known car seconds of delay in the street having the red light, against the car seconds of delay which would result were moving traffic of known density and spacing to be stopped on the street having the green light. By this process of automatic and continuous balance it is possible not only to eliminate all unnecessary delay but materially to reduce the total delay at the intersection.

Since a complete record is kept of the vehicles at the intersection including not only the number of the vehicles but also their position with respect to each other, this dispatcher is adapted ideally to the handling of platoons of vehicles. The dispatcher has been designed with the intent to expedite efficiently and smoothly the through movement of platoons of vehicles, without physical interconnection, at a series of intersections controlled by model 1022 dispatchers.

INITIAL INTERVALS

There is set up on the dispatcher, by means of a dial for each phase, the total number of vehicles which should be expected to clear on each phase. Since the dispatcher keeps a continuous record of the number of vehicles which have been stopped when the signal is red, it can determine the number of additional vehicles which will have to be cleared through the intersection on the next green light. An additional increment of green period will be given every vehicle which has been stopped at the intersection in excess of the number of vehicles which can be cleared on the minimum green period. This increment per car is adjustable on the dial panel of the dispatcher for each phase.



Close-up view of new traffic signal dispatcher which controls traffic automatically

VEHICLES PASSAGE INTERVAL

Under light traffic conditions the right of way on a particular phase will be held as long as there are any cars between the detector and the intersection as they will be calling for a full Vehicle Passage Interval. Upon the expiration of a Vehicle Passage Interval the dispatcher can yield to the other phase if there is a car waiting there. Under intermediate and heavy traffic conditions, the right of way may be taken away from the vehicle by other impulses recorded in the dispatcher. If the right of way is taken away from a vehicle without allotting it a full Vehicle Passage Interval that vehicle will be remembered and at the next opportunity in the cycle the right of way will again be shown to the vehicle.

In order to indicate just how the dispatcher is handling the traffic, that is to say, whether the right of way is transferred by traffic density, or by traffic delay or waiting time, or by some other of the various dispatcher functions, a series of 13 indicator lights are visible from the front of the dispatcher. By watching these indicator lights flash, it is possible to see just what the dispatcher is thinking and actually doing about the distribution of the right of way.

The working parts of the dispatcher consist mainly of interconnected relays operating in conjunction with static timing circuits. The actual timing of the various circuits is measured by the length of time required for a timing condenser to reach a predetermined voltage when supplied with a direct current voltage through a variable resistance controlled by the front panel knobs. When the timing condenser reaches the correct voltage, an electrical circuit is completed through a gaseous discharge vacuum tube to operate the various dispatcher relays.

INSTALLED AT MILLBRAE

The recent installation of this new type dispatcher at Millbrae Avenue and El Camino Real (U. S. 101) in San Mateo County has met with considerable favor. Actual checks at the intersection show that the amount of vehicle delay on any of the traffic legs is very small.

Diner: "Are you the young lady who took my order?"
Waitress: "Yes, sir."
Diner: "Well, you're looking fine. How are your grandchildren?"

Metal Guard Rails Replace Curbs

By HARLAN PERDEW, District Traffic Engineer

EFFECTIVENESS of metal guard rails at road intersections as an aid to traffic control has been definitely established by the Division of Highways. Their superiority over concrete curbs and double stripes with plant-mixed bars in areas where highways are subjected to seasonal sand drifts has been conclusively demonstrated.

On an important highway project recently completed, metal guard rails obtained before priorities on critical materials went into effect, were installed at intersections for the first time in the history of the department. The highway in question traverses a section of Central California in which the soil is primarily fine sand with occasional vegetation. During certain periods of the year strong winds are prevalent in this district and cause frequent sand drifting.

Guard rail fabricated at factory for curve and difference in elevation of two roadways

21 OPENINGS IN STRIP

The project on which the guard rails were used is a four-lane highway with a 30-foot undeveloped division strip. During its construction 21 openings were provided in the division strip within a distance of approximately 4½ miles. Several of the openings were unpaved and other paved ones were so wide as to make control of traffic very difficult.

The original plan for the improvement provided for the closing of 12 of the openings and establishment of more positive traffic control at the remaining openings. Most of the major openings were from 80 to 100 feet in width.

THREE METHODS PROPOSED

As an aid to traffic control, it was decided to restrict the width of these openings. Three methods were discussed for accomplishing this; namely, double stripes with plant-mix bars, concrete curbs and guard rail. The double stripes and bars were eliminated as having insufficient positive control. Concrete curbs would have provided the positive control, but with drifting sand it was felt that the curbs would frequently be entirely covered necessitating considerable maintenance and reducing the effectiveness thereof. The guard rail, it was decided, would permit the sand to blow clear of the openings without reducing the effectiveness of barrier.

After installation it was found that the metal guard rail used had other advantages that far exceeded those which originally justified its use. These advantages were as follows:

1. Installation was simple and maintenance costs will be minor.
2. The center of the rail is 19 inches above the pavement and is visible to motorists at all times. This is particularly important for vehicles negotiating a turn as the rail can be followed without loss of visibility to the driver.
3. Intersections are more definitely defined to both day and night traffic. The white guard rail at night stands out from a dark background and is visible for several hundred feet from the intersection.
4. It is anticipated that the guard rail will prove to be safer than curbing as there will be less tendency to collide with it and in case of a collision the resiliency of the metal rail will prevent serious accident.

Turning movements restricted by use of metal guard rail at intersection where two roadways are at same level

Congress Votes $39,019,000 to Carry on Central Valley Project

(Continued from page 1)

to complete all the engineering work necessary in preparation for the construction of the Antioch steam plant.

The committee also recommended that the "Secretary of the Interior and the Pacific Gas and Electric Company immediately enter into a contract, for the duration of the war and a reasonable time thereafter, for the complete pooling of all public and private power facilities which will result in delivering the greatest amount of power to war industries in the least possible time and with the greatest economy in the use of critical and strategic materials. Any such contract should provide for recapture, without prejudice, of any advantages which temporarily may accrue to either party."

The Senate report also declared: "* * * in order to make certain that a fixed policy is not to be abandoned by failure of appropriate funds to carry it into effect, it is recommended that the $3,723,000 heretofore appropriated for the Central Valley Project transmission system be restored to the bill.

"* * * The breakdown of the sum contained in the bill for the Central Valley Project as passed by the House earmarks $1,000,000 for the construction of the Friant-Kern Canal. In order to make available additional lands for the production of foods, fiber, rubber and other materials to meet war needs it is recommended that this allocation be increased to $1,250,000 and that the entire amount be available for construction of both the Friant-Kern and Madera canals to advance supplemental water service to highly productive lands under each of said canals badly in need of more water."

The effect of this action was to take the million dollars specifically earmarked by the House for construction of the Friant-Kern Canal and make it and an additional $250,000 available for construction on either or both the Friant-Kern and Madera canals.

Representatives of the Water Project Authority appeared before both House and Senate committees and vigorously supported appropriations for both the irrigation and power features of the Central Valley Project as set up in the President's Budget. The authority also filed statements and data with both committees in support of the appropriations.

Following action by the Interior Subcommittee of the House Appropriations Committee eliminating funds for the transmission line and Antioch steam-electric plant, President Roosevelt personally addressed a letter to Senator Carl Hayden, Chairman of the Interior Subcommittee of the Senate Appropriations Committee pointing out the importance of these funds to the ultimate success of the project.

Governor Culbert L. Olson actively entered the fight for restoration of the funds as did George Sehlmeyer, Master of the State Grange, who made a trip to Washington to appear before the Senate Appropriations Committee in support of the Central Valley Project appropriations. Many cities and organizations throughout the Central Valley passed resolutions and wired their Washington representatives urging that adequate funds be provided, not only for the irrigation features of the project, but for the transmission line and steam-electric plant at Antioch as well.

Opposition to the power features of the project came from Pacific Gas and Electric Company representatives who appeared and filed statements before both the House and Senate committees.

TURNPIKE HISTORY

The word "turnpike"—given toll roads—originated from the early American and English custom of blocking toll roads with pikes or poles, according to the Automobile Club of Southern California. When the toll was paid, the pike was turned aside. The first turnpike road was built in 1793 between Philadelphia and Lancaster, Pennsylvania, and was known as the Lancaster Turnpike. It was 62 miles in length and also was the first macadam road in the United States.

Dynamite and Snowplows Conquer Sonora Pass

Sonora Junction. This highway crosses the summit in Sonora Pass at an elevation of 9,624 feet, being the second highest highway crossing in the State highway system, exceeded only by Tioga Pass, 9,941 feet. This pass lies between Sonora Peak, elevation 11,420 feet, on the north, and Leavitt Peak, elevation 11,575 feet, on the south. The boundary line between District IX and District X is at the summit of Sonora Pass. The highway on both sides of the pass is on steep and winding grades, rising in the west from the foot of the grade at Kennedy Meadow, elevation 6,300 feet, a distance of 3,300 feet in nine miles, and descending on the east slope to Leavitt Meadow, elevation 7,152 feet, a drop of approximately 2,500 feet in a distance of eight miles. Scenery on this 17-mile section is extremely spectacular. Many world travelers have proclaimed the rugged grandeur of Sonora Pass to be unsurpassed, not excluding in their consideration the world-famous European Alpine scenery.

Snow removal operations on the approaches to the pass are difficult, due to the steep and winding grades, the heavy snow pack, and the low temperatures. Plowing was started this year at Strawberry, elevation 5,240 feet, 37 miles west of Sonora Pass, on May 14, three weeks later than last year. Baker Station, at the foot of Sonora Pass, was reached May 19 and operations temporarily suspended. On May 27 an attempt was made to open the highway to the head of Blue Canyon, approximately two miles west of the summit. The work was suspended on the second day during a blinding snow storm while still one mile short of the goal. After an interval of 11 days, operations were resumed, this time with the summit of the pass as the goal. Six days were required to reach the summit, and an additional two days for widening through the deep cuts. In the meantime, the plow from District IX was clearing the eastern slope. As a result of excellent timing, these two plows met on June 17 on the boundary between the two Districts.

Old Man Winter was finally conquered and a veritable Mecca made accessible to the sportsman, nature lover and tourist until some time next fall when the forces of nature will again combine to put the high Sierra to sleep.

Establishing The Oil Content For Dense Graded Bituminous Mixtures

By F. N. HVEEM*

PROBABLY the first and most frequent question which the bituminous paving engineer is required to answer concerns the quantity of binder which would be most satisfactory when mixed with a given aggregate. In the early years engineers relied on personal experience and usually decided on the proper amount of asphalt by visual inspection of the mix. Many rule of thumb guides have been employed ranging from appearance and "feel" of an asphaltic concrete mix to the "wormy crawl" and chocolate brown color thought to identify a proper oil mix. More scientific procedures include stain tests, proportioning by void ratio, and a number of formulas usually based on the sieve analysis of the aggregate.

Among the formulas probably the best known is the McKesson-Frickstad developed for the oil mix type of pavement. Several modifications of the McKesson-Frickstad formula have been developed in the Western States among which are the New Mexico, Nebraska and Wyoming Formula, etc. In California the procedure followed for the past 10 years is the Surface Area Method.[1]

State of California — Division of Highways — Materials & Research Dept.

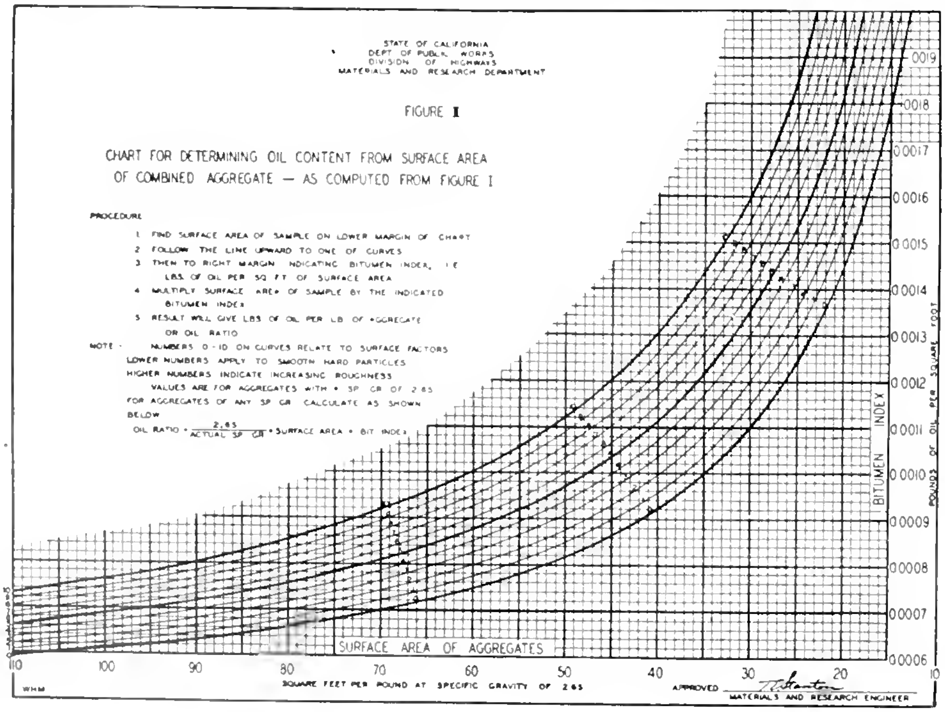
TABLE OF SURFACE AREA EQUIVALENTS

Table 1 10 Sieves			Table 2 7 Sieves			Table 3 6 Sieves			Table 4 4 Sieves			Table 5 4 Sieves			Table 6 3 Sieves		
Sieve No. Pass.	Ret.	Constant	Sieve No. Pass.	Ret.	Constant	Sieve No. Pass.	Ret.	Constant	Sieve No. Pass.	Ret.	Constant	Sieve No. Pass.	Ret.	Constant	Sieve No. Pass.	Ret.	Constant
270*		300															
200	270	200	200		260	200		260	200		260	200		260	200		260
100	200	120	100	200	120												
50	100	60				50	200	90	50	200	90						
30	50	30	30	100	46							30	200	72			
16	30	16				16	50	22									
8	16	8	8	30	12				8	50	17				8	200	45
4	8	4	4	8	4	4	16	6				4	30	9			
3/8	4	2	3/8	4	2 } 2	3/8	4	2 } 2									
3/4	3/8	1	3/4	3/8	1 }	3/4	3/8	1 }	3/4	8	2	3/4	4	2	3/4	8	2

* Silt remaining in suspension and removed by elutriation.

Note: Value shown in Tables 2, 3, 4, 5, & 6 for passing #200 sieve applies to average dust. Will be in error for some materials.

APPLICATION: Use table according to number of test sieves used. Reducing number of sieves will reduce accuracy. By sieve analysis determine the amount of each size of aggregate. Express in terms of per cent of total. Multiply the per cent of each size by the constant given for that size. The constant is the equivalent area in sq. ft. of one pound of material of that size. Add results and total will represent surface area of the entire sample in terms of square feet per pound.



Most engineers have long been aware that the optimum quantity of asphalt bears no consistent relation to the volume of voids in the mixture and the rather widespread application of methods based on the surface area of the aggregate indicates that the quantity of asphalt is more nearly related to the superficial surface area than to any other simple factor. For example, the surface area method as used in California has been reasonably satisfactory and can be expected to give quite close approximations in the hands of experienced engineers. Nevertheless, any preliminary estimation of asphalt based on surface analysis alone has possibilities for error and it has been evident for some time that improvements or additions to the

* Senior Physical Testing Engineer, Materials and Research Department, California Division of Highways.

[1] "Role of the Laboratory in the Preliminary Investigation and Control of Materials for Low Cost Bituminous Pavements" by Thos. E. Stanton, Jr., and F. N. Hveem, presented at the Fourteenth Annual Meeting of the Highway Research Board, December, 1934.

method are desirable; first, in order to make the method more universally applicable and second, to reduce the time and experience required.

SURFACE AREA METHOD

A brief summary of the surface area method is as follows:

Hypothesis. The quantity of asphalt required to bind particles of mineral aggregate together to form a stable paving mixture will bear some relation to the superficial surface area of particles to be covered; although the quantity can not be calculated as a direct simple function of surface area alone.

The determination is complicated by other factors which may be analyzed as follows:

Internal friction is the major element contributing to bituminous pavement stability and as asphalt is a lubricant, that property serves to limit the quantity which can be used without destroying the stability of the mixture. Lubrication effects depend upon the roughness of the solid surface as well as the thickness and viscosity of the lubricating film and any predetermination of the optimum binder content must take into account both surface area and the character of the particles. The surface area method involves the calculation of surface area through the use of constants assigned to the various particle sizes as determined by standard testing sieves **(See Table 1)**. After

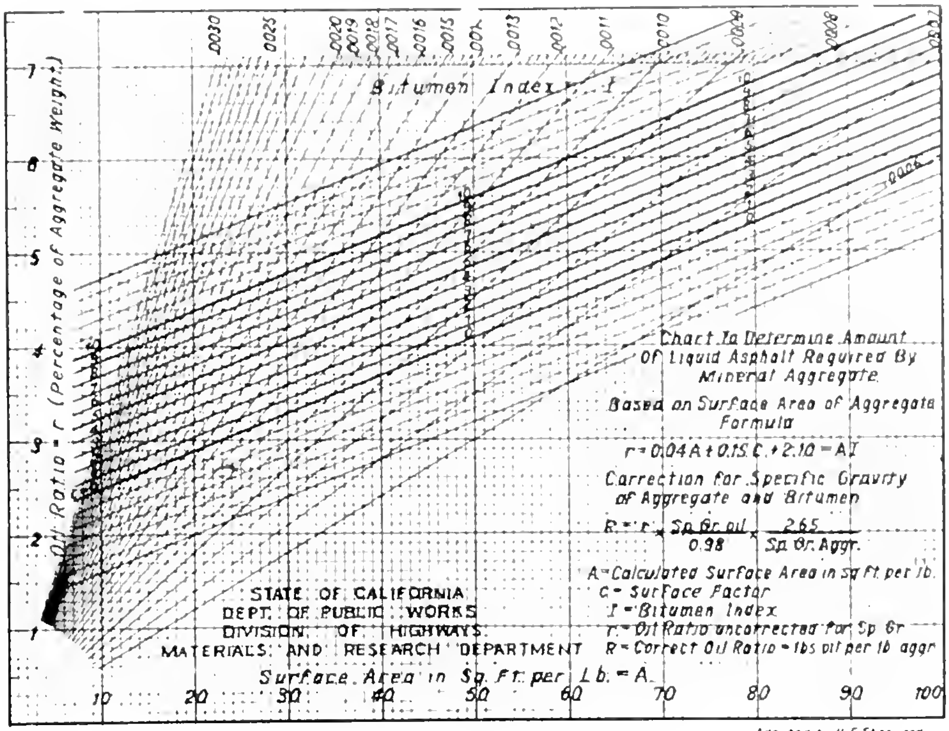


FIGURE II

Adopted by H F Sherwood
Sheet 1 of 2

having calculated the surface area it is then necessary to determine the bitumen index or the quantity of asphalt required to cover one unit of available surface. It was found that the bitumen index or film thickness must vary as an inverse function of the surface area indicating that in order to form a stable mix a *group* of small particles must be coated with a thinner film than can be used on a group of large particles. This relationship is shown by the shape of the curves in **Figure 1**.

AGGREGATE GRADATION

In addition to this variable caused by differences in aggregate graduation, an allowance must be made for the character of the particle surface. This means that rough irregular particles have a greater surface area and are less easily lubricated than smooth polished grains. Therefore, a thicker film of oil or asphalt can be used on particles of crushed lava or sandstone than will be tolerated by particles of quartz or chert. These differences are covered arbitrarily by the series of curves shown on **Figure 1**. The lower curves apply to particles with a smooth glassy surface and the higher curves apply to particles of increasing roughness. The essential operations are covered by the notations on **Table 1** and on the Chart, **Figure 1**, and consist of the following steps: sieve analyses of the aggregate, calculation of the surface area, selection of the surface factor curve corresponding to the particle roughness. The bitumen index is then determined from the combination of *assumed* surface factor and *calculated* surface area using chart, **Figure 1**. The product of the bitumen index and surface area value represents the oil ratio after corrections have been made for specific

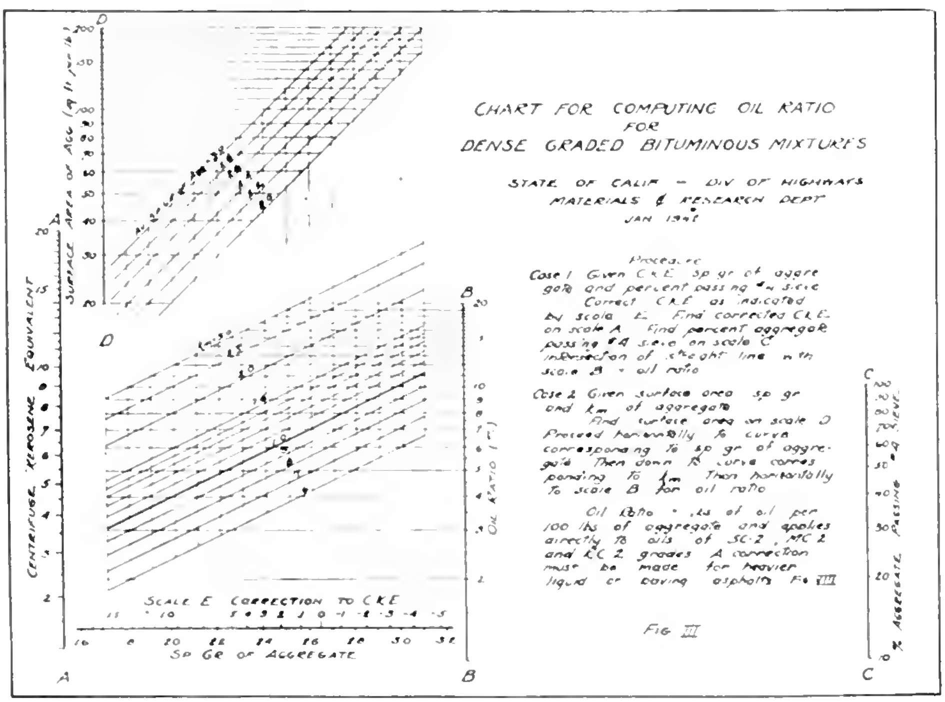


Fig III

gravity of both asphalt and aggregate. This relationship is shown also by chart, **Figure II**, where the surface factor curves are straight lines and the oil ratio may be read directly.

SIEVE ANALYSIS

The accuracy of the foregoing method of determination therefore rests on the sieve analysis and the ability of the engineer to select a surface factor curve which is appropriate for the particular aggregate. This operation presents some difficulties to the inexperienced engineer or to the laboratory not equipped with a stabilometer or other means for actually measuring the degree of lubrication in the mix. Furthermore, while particle roughness may be approximately classified by inspection, true absorption of the aggregate is difficult to evaluate without tests and it is well known that many oil mixtures become dry and display a tendency to ravel subsequent to construction, even though apparently containing sufficient oil when first mixed. Many bituminous paving engineers have realized that some accurate method is needed for anticipating absorption of oil on the road. In California this difficulty was to some extent met in the laboratory by adding additional oil to samples after a preliminary drying period. In Utah Mr. Levi Muir has long employed an absorption test but as this procedure engenders considerable delay in the handling of tests, a method has been developed and is described herewith which requires the use of only simple equipment to give a rapid approximation of the ultimate absorption capacity of the aggregate and which also can be used for predetermination of the oil content without preliminary sieve analysis.

CENTRIFUGE KEROSENE EQUIVALENT

It has long been realized that a logical step from the calculation of the surface area would be the development of some means for accurately measuring the superficial surface area *or surface capacity* of irregular particles without the need for time consuming sieve analysis and calculations which at best give only approximate results.

About 10 years ago it was found that the oil or asphalt requirement of filler dust could be closely estimated by observing the height to which a limited quantity of kerosene would be drawn through a column of dust

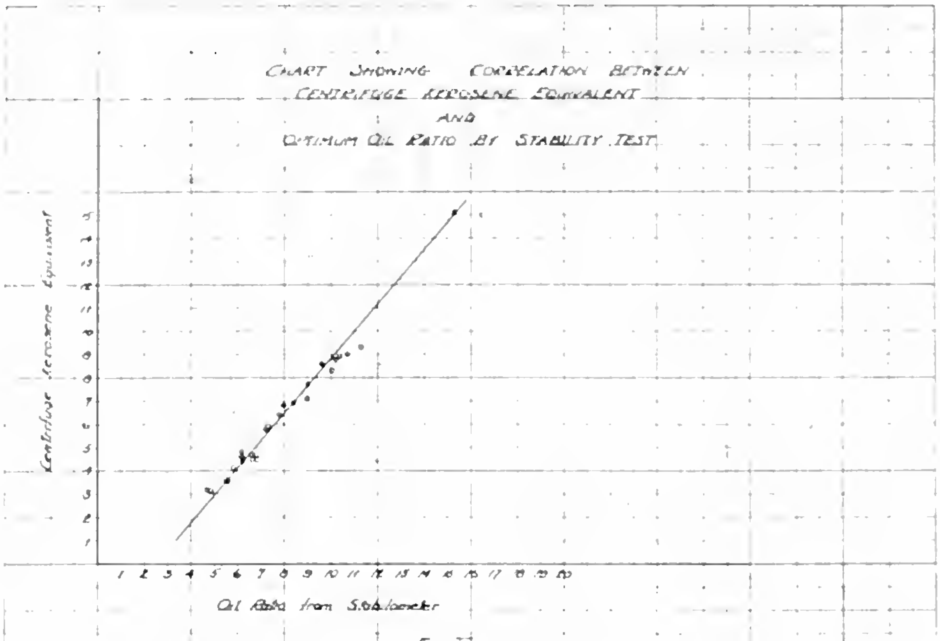


FIG IV

placed in a glass graduate. Attempts were made to apply the procedure to graded sands up to 10 mesh but results were not completely consistent; however, this does not mean that the possibilities were completely explored.

It can also be shown that very good results are obtainable by selecting a closely screened fraction of sand and coating to a uniform film thickness with liquid asphalt; this method called the "Funnel Test" was used for over a year in the California Laboratory and has the advantage of requiring no special equipment but does require sieve analysis and from one to two hours to complete the operation. It has been dropped in favor of the more rapid method described below.

One common factor stands out in all the more promising experiments and trials: It is evident that any determination based on the use of a standard liquid **must develop conditions wherein the particles are covered by a film of the liquid without any excess being held in the voids between the particles.**

KANE METHOD

During the course of these studies a related method was reported by one of the field engineers, Mr. C. V. Kane, then Resident Engineer for the California Division of Highways. Kane's method consisted of saturating an aggregate with gasoline and then draining off the excess through a 200 mesh sieve at room temperature. A chart was developed for translating the quantity of gasoline retained in the sample to the equivalent optimum oil ratio of the aggregate. However, when this procedure was investigated in the laboratory it was soon found that it was applicable only to a limited variety of materials and gradations and it was also evident that the errors were due to the gasoline not draining out of the small voids in dense graded mixtures. Pursuing the idea that the liquid must be removed from the voids or pores in the aggregate, centrifuging was resorted to; first, using a standard centrifuge operating at a speed equivalent to 1,000 times gravity as prescribed for the centrifuge moisture determination on soils.

After a number of trials and adjustments a test procedure was developed which appears to have excellent correlation with the stability test and consequently with field experience. In order to provide a medium free from immediate evaporation losses, ordinary kerosene is used to saturate a sample of aggregate. By a series of trials the speed of the centrifuge was reduced to give a force equivalent to 400 times gravity. It became clearly evident that a nice proportionality must be maintained between the viscosity of the liquid used and the force employed to remove the excess from the voids in the sample. The surface capacity of an aggregate is composed of three factors; namely, surface area which varies with gradation, variation due to roughness of the particle surfaces, and variation due to true porosity or absorption into the particles themselves. Therefore, the speed of the centrifuge must be adjusted so that a proper relation will be maintained between the film of kerosene on the surface of the particles and the quantity absorbed within the particles.

Briefly then, the procedure consists of saturating a representative fraction of the aggregate passing the No. 4 sieve with kerosene and then centrifuging for two minutes under a force equal to 400 G. The quantity of kerosene retained by the sample has been designated "The Centrifuge Kerosene Equivalent."

For those interested in the theoretical considerations involved, the following brief discussion including some of the mathematical relations may be of interest.

DEVELOPMENT OF THE METHOD

The limiting condition for extended increase of bitumen content in a paving mixture is the loss of stability in the mixture. Therefore, using stabilometer tests to determine this limit the relation between the optimum oil ratio and surface area was reinvestigated using a variety of aggregates in a number of gradations. This study indicated the desirability of revising the surface factor curves formerly used with the surface area method; and as the original group of 10 curves had been found insufficient to cover the entire range from very smooth to highly absorbent aggregates, a new system has been established to permit unlimited expansion and is based on the use of a new surface factor designated as "K."

This relationship is shown on chart, **Figure III**, and is so arranged that the value of $K = 1.0$ represents the average most-frequently-encountered aggregate which has little, if any, absorption and is equivalent to the older surface area curve No. 4. **(See Fig. I)** which, after years of experience, has seemed to be most frequently used for the common run of aggregates encountered in California. Hard trap rock, dense basalt, crushed granite or crushed hard limestone are some of the types represented by $K = 1.0$. Aggregates of increasing porosity or surface roughness are covered by high values of K, while particles having smoother and more polished surfaces are indicated by values less than 1.0. The entire relationship is then shown by chart, **Fig. III**, which, with calculated surface area corrected for specific gravity and the correct selection of the factor "K" to indicate the surface texture and porosity of the particles, permits an accurate determination of the oil ratio or weight of liquid asphalt required per unit weight of aggregate.

OPTIMUM OIL RATIO

Experiments with the Centrifuge Kerosene Equivalent have also demonstrated that there is an excellent direct correlation between these values and the optimum oil ratio as determined by stabilometer tests on trial mixtures. This relationship is shown on chart, **Figure IV**.

From these two relations it is possible to develop a mathematical expression for the optimum oil ratio in terms of the C.K.E., the percentage of aggregate passing a No. 4 sieve, and the average specific gravity of the aggregate.

Neglecting the specific gravity temporarily for simplification:

The relation between optimum oil ratio and the surface area of the aggregate as shown on **Figure III** can be expressed by the following formula:

$$\text{Oil Ratio}_{mix} = K_m \; .0067 \sqrt{SA_{mix}} \qquad (a)$$

when K_m = Surf. Constant of the entire mix *

SA_{mix} = Surf. area of the entire mix

The relation between optimum oil ratio and C.K.E. as shown on chart, **Figure IV**, may be expressed by the formula:

$$\text{Oil Ratio}_{pass\ no\ 4} = \frac{0.85 \text{ C.K.E.} + 2.5}{100} \qquad (b)$$

Equation (a) applies to any part of the aggregate mixture, so writing it for the passing No. 4 we have:

$$\text{Oil Ratio}_{pass\ no\ 4} = K_f \; .0067 \sqrt{SA_{pass\ no\ 4}} \qquad (c)$$

where K_f = surf. constant for the passing No. 4 aggregate

$SA_{pass\ no\ 4}$ = surf. area of the passing No. 4 aggregate

Combining equation (c) with equation (b):

$$\frac{0.85 \text{ C.K.E.} + 2.5}{100} = K_f \; .0067 \sqrt{SA_{pass\ no\ 4}} \qquad (d)$$

Since the surface area of the aggregate retained on the No. 4 sieve is small compared to the surface area of that passing the No. 4, we may write the following approximate relation:

$$SA_{pass\ no\ 4} = \frac{SA_{mix} \times 100}{\%\ \text{passing No. 4}} \qquad (e)$$

* Surface factors are designated as K_c, surface constant for the coarse aggregate retained No. 4; K_f, surface constant for the fine aggregate passing No. 4; K_m, surface constant of any given combination of coarse and fine aggregate. Further values could be individually assigned to any fraction of the aggregate as desired.

It has been found by experience that except for rare cases where a fine aggregate passing the No. 4 sieve is blended with coarse aggregate of greatly different surface characteristics the surface constant for the entire mix K_m is not significantly different from that for the material passing the No. 4 represented by K_f.

So substituting K_m for K_f

and $\dfrac{SA_{mix} \times 100}{\%\ \text{passing No. 4}}$ for $SA_{pass\ no\ 4}$

in equation (d) and solving for K_m we have:

$$K_m = \frac{0.85 \text{ C.K.E.} + 2.5}{100 \times .0067 \sqrt{\dfrac{SA_{mix} \times 100}{\%\ \text{Passing No. 4}}}} \qquad (f)$$

Substituting this in equation (a):

$$\text{Oil Ratio}_{mix} = \frac{(0.85 \text{C.K.E.} + 2.5)\sqrt{.0067}\,SA_{mix}}{100 \times .0067 \sqrt{\dfrac{SA_{mix} \times 100}{\%\ \text{passing No. 4}}}}$$

Simplifying:

$$\text{Oil Ratio}_{mix} = (0.85 \text{ C.K.E.} + 2.5) \sqrt{\frac{\%\ \text{passing No. 4}}{100}} \qquad (g)$$

From this we see that the oil ratio may be estimated from the C.K.E. and the amount passing the No. 4 sieve as long as the *character* of particles smaller than No. 4 are similar to the particles retained on the No. 4.

If the specific gravity of the aggregate is materially above or below 2.65 a correction must be applied to the C.K.C. An alignment chart (See Scales A, B, & C on chart, Fig. III) has been constructed corresponding to formula g) with a specific gravity correction scale appended at the bottom of the sheet.

The second installment of this article will appear in the August issue of this magazine.

Public Works Man Is Lexington Survivor

From the calm and security of a desk in the Accounting Department of the Division of Highways in Sacramento to the flaming, shell-ridden deck of the aircraft carrier Lexington in the Coral Sea is the unforgettable transition experienced by Robert Zaniboni in the space of a few months.

With 16 shipmates, Zaniboni was trapped in a compartment of the Lexington when exploding gasoline fumes set the crippled craft ablaze after she had survived deadly Japanese air attacks. Zaniboni was the only one of his group to emerge alive.

California Highway Commission Appoints L. L. Penfield Secretary

Gasoline Rationing Affects Traffic on Recreational Roads

Survey Party Adapts Radio Device to Defeat Traffic Noises

Public Is Urged To Protect Watersheds From Fire Hazards

THE war confronts California with the toughest over-all fire problem to be found in the United States. It intensifies the already dangerous fire hazards within our forests and watersheds, not only because of acts of sabotage and incendiarism by enemies, but also through the acute and growing shortage of manpower and the difficulties of obtaining much needed additional equipment.

The California State Council of Defense, Division of Forestry and the State Board of Forestry and cooperating agencies are trying to meet this shortage in various ways:

1. By building up an auxiliary force, for use in emergencies, of high school and college students who will be trained in fire fighting techniques.
2. By organizing farm workers as volunteer firemen.
3. By using prison labor.
4. By recruitment from any and all other sources.

Kenneth I. Fulton, Director of Natural Resources, on behalf of the California Division of Forestry, urges the public to be extra careful with cigarettes, camp fires, and automobiles, but also to report fires to the State rangers or other constituted authority. The Division of Forestry is relying upon the press as the chief means of educating and urging the people to help in preserving their own natural resources.

Transportation Vital

I am deeply concerned as to the consequences of the diminishing supply of private and commercial motor vehicle transportation. It is certain that unless stringent steps are immediately taken to conserve the life of vehicles, and particularly their tires, we will soon be faced with a tragic shortage of highway transportation essential to the war effort.

THOS. H. MacDONALD
Commissioner U. S. Public Roads Administration

Robert H. Root New Assistant Director of Public Works

APPOINTMENT of Robert H Root of Sacramento as Assistant Director of the Department of Public Works, is announced by Frank W. Clark, Public Works Director. Mr. Root succeeds Franz R. Sachse, who resigned last month to accept a commission in the United States Air Force.

For the past nine months, Mr. Root has been a member of the State Board of Control, which position he resigned. He was formerly manager of the Capital Lumber Co. of Sacramento and manager of the Material Dealers' Association.

Born in New York, Mr. Root attended grade schools in Pennsylvania and in 1916 enlisted in the British Army, serving until the United States entered the war, when he was transferred to the A. E. F. He is a member of Post 61 of the American Legion, Sacramento.

Following the war, Mr. Root resumed his studies in England and came to Sacramento in 1921. He is past president of the Junior Chamber of Commerce of Sacramento, past State Director of the California Junior Chamber of Commerce and Past President of the 20-30 Club of Sacramento.

ROBERT H. ROOT

Last Bucket of Concrete Poured at Friant Dam

IN marked contrast to the ground breaking ceremonies, less than three years ago when 40,000 people gathered to witness the start of work on Friant Dam, the final cubic yard of concrete was placed in the dam on June 16th without fanfare.

Friant Dam, the fourth largest concrete structure in the world, was built as a part of the Central Valley Project. R. B. Williams, construction engineer, in a report to R. S. Calland, district engineer of the United States Bureau of Reclamation, said 2,130,480 cubic yards of concrete had been poured in the dam.

Pouring of the final bucket of concrete does not mean that the dam is complete. Because of the lack of priorities for materials, spillway gates and outlet valves can not be installed at this time.

Ground was broken for Friant Dam on November 5, 1939. The first bucket of concrete was poured on July 29, 1940. During the construction period a California record for the amount of concrete poured in one month was set in August, 1941, when 228,769 cubic yards was placed.

Friant Dam impounds the San Joaquin River about 20 miles northeast of Fresno. A straight gravity type dam, it is 320 feet high, 3,430 feet long at the crest and 265 feet wide at the base.

Millerton Lake, the reservoir created by the dam, has a capacity of 520,00 acre-feet of water. It will be used to control flood waters of the San Joaquin River and provide an irrigation supply for lands in Madera, Fresno, Tulare, Kings and Kern counties. Irrigation water will be diverted through the Friant-Kern Canal, extending 160 miles south to Bakersfield and the Madera Canal, running north to the Chowchilla River.

Highway Bids and Awards for the Month of June, 1942

HUMBOLDT COUNTY—Between Loleta and Salmon Creek, about 2.7 miles to be resurfaced with plant-mixed surfacing on gravel base. District I, Route 1, Section G. Contract awarded to Mercer, Fraser Co., Eureka, $39,545.

LOS ANGELES COUNTY—Between Carson Street and Center Street, about 3.8 miles to be graded and paved with asphalt concrete and Portland cement concrete. District VII, Route 168, Section A,L.Bch. Griffith Co., Los Angeles, $375,218; Oswald Bros., Los Angeles, $439,628; United Concrete Pipe Corp., Los Angeles, $493,335. Contract awarded to Sully Miller Contracting Co., Long Beach, $359,015.

LOS ANGELES COUNTY—At the intersection of Atlantic Blvd. and Olive St., a traffic signal system to be furnished and installed. District VII, Route 167, Section A. Johnny Walker, Los Angeles, $8,250; C. D. Draucker, Inc., Los Angeles, $8,355. Contract awarded to Econolite Corp., Los Angeles, $7,538.

LOS ANGELES COUNTY—At the intersection of Atlantic Blvd. and Compton Blvd., a traffic signal system to be furnished and installed. District VII, Route 167, Section A. Econolite Corp., Los Angeles, $7,350; Johnny Walker, Los Angeles, $7,900. Contract awarded to C. D. Draucker, Inc., Los Angeles, $7,219.

MENDOCINO COUNTY—Between Flynn Creek and Navarro, about 1.9 mile to be graded and surfaced with road-mixed surfacing. District I, Route 48, Section C. Guerin Bros., So. San Francisco, $88,823. Contract awarded to John Burman & Sons, Eureka, $57,357.

MONTEREY COUNTY—Two pedestrian crossings to be constructed, one over and one under Route 56 and the tracks of the Southern Pacific Railroad at Fort Ord. District V, Route 56, Section I. Harry J. Oser & Peter Sorensen, Redwood City, $89,341; Granite Construction Co., Watsonville, $84,879. Contract awarded to Dan Caputo, San Jose, $77,939.

SAN DIEGO COUNTY—A composite concrete and timber bridge across Campo Creek at Campo to be constructed and approximately 0.2 mile of roadway approaches thereto to be graded and surfaced with bituminous surface treatment. District XI, Route 200, Section D. R. E. Hazard & Sons, San Diego, $42,948; R. L. Oakley, Pasadena, $46,253. Contract awarded to Geo. J. Bock Co., Los Angeles, $31,230.

SAN DIEGO COUNTY—At Mission Valley Road across Pacific Highway and the tracks of the A.T.&S.F. Ry in the city of San Diego, a reinforced concrete overcrossing on timber piles together with ramps and approaches to be constructed. District XI, Mission Valley Road. Byerts & Dunn & W. J. Disteli, Los Angeles, $507,472; R. E. Hazard & Sons, San Diego, $526,718; Carlo Bongiovanni, Los Angeles, $541,219; United Concrete Pipe Corp. & A. S. Vinnell Co., Los Angeles, $569,358; Oberg Bros. & Oscar Oberg, Los Angeles, $575,616. Contract awarded to Griffith Co., Los Angeles, $499,708.

SAN DIEGO COUNTY—Across Seventh St. Channel in National City, two reinforced concrete bridges to be constructed. District XI. The Contracting Engineers Co., Los Angeles, $48,801; Oberg Bros., Los Angeles, $49,244; R. L. Oakley, Pasadena, $53,218. Contract awarded to Bent Co., Los Angeles, $44,921.

SAN MATEO COUNTY—Between Fifth Avenue in San Mateo and the north city limits of Redwood City about 6.4 miles to be repaired by placing imported borrow and surfacing with plant-mixed surfacing. District IV, Route 68, Section S.M.,C.Bmt. A. J. Raisch, San Jose, $143,135; L. C. Smith, San Mateo, $160,725; Marshall S. Hanrahan, Redwood City, $218,810. Contract awarded to Union Paving Co., San Francisco, $138,515.

SANTA CRUZ COUNTY—Between Watsonville and Rob Roy Junction, about 7.8 miles to be surfaced with armor coat. District IV, Routes 32, 56, Section Wat.,B.D. Paul J. Tyler & Parish Bros., Sacramento, $63,032; L. A. Brisco, Arroyo Grande, $73,457. Contract awarded to Walter J. Wilkinson & H. B. Scott, Watsonville, $55,904.

SHASTA COUNTY—At points between one and four miles south of Redding, four bridges to be constructed and two bridges to be widened. District II, Route 3, Section A. J. P. Brennan, Redding, $97,082; Harry J. Oser & Peter Sorensen, Redwood City, $114,499. Contract awarded to Kiss Crane Service, Berkeley, $72,796.

SISKIYOU COUNTY—Between Cougar and Macdoel, about 24.2 miles to be repaired by placing imported borrow and plant-mixed surfacing. District II, Route 72, Section B. J. A. Casson Co., Hayward, $163,035; W. P. Powell, Los Angeles, $176,007. Contract awarded to Poulos & McEwen, Sacramento, $151,651.

SOLANO COUNTY—Between 0.5 mile east of Vallejo and Benicia Arsenal, about 6.2 miles to be graded and surfaced with asphalt concrete on crusher run base. District X, Routes 7, 74, Section FG, B, Ben. Piazza and Huntley & J. M. Ruddy, San Jose, $697,391. Contract awarded to Paul J. Tyler & Parish Bros., Sacramento, $543,330.

SOLANO COUNTY—Between Junction with Route 74 near Flosden and the Walnut Street entrance into Mare Island, about 2.2 miles to be graded and paved with Portland cement concrete and plant-mixed surfacing on Portland cement concrete base. District X, Route 208, Sections B,A. Fredericksen & Westbrook, Sacramento, $224,779; Chas. L. Harney, San Francisco, $285,773. Contract awarded to Heafey-Moore Co., Oakland, $217,125.

VENTURA COUNTY—Near Oxnard, an area to be graded and surfaced with plant-mixed surfacing. District VII. Byerts & Dunn & N. Moore, Los Angeles, $236,485; A. S. Vinnell Co., Alhambra, $249,718; Bert Calvert & S. Edmondson & Sons, Los Angeles, $277,518; Oswald Bros., Los Angeles, $317,518; W. E. Hall Co., Alhambra, $338,103. Contract awarded to Vido Kovacevich, South Gate, $210,628.

YUBA COUNTY—Between Morrison Xing and Camp Beale, about 3.8 miles to be graded and surfaced with crushed gravel base and plant-mixed surfacing. District III, Route 3, Section A,B,Camp Beale. Marshall S. Hanrahan, Redwood City, $245,883; Fredericksen & Westbrook, Sacramento, $247,187; A. Teichert & Son, Inc., Sacramento, $251,339; Basich Bros., Torrance, $268,010. Contract awarded to Hemstreet & Bell, Marysville, $238,866.

Freshman: "I must apologize for my dancing. I'm a little stiff from badminton."

Co-ed: "Why should I care where you're from?"

Wrong-Way Driver Compels Barriers

(Continued from page 7)

travels on the Parkway has been involved in an accident of any consequence, but in order to protect the one million from the one, traffic engineers of the Division of Highways, after considerable investigation and study of the problem, set about developing a means of controlling these erratic drivers.

As a consequence, islands, or neutral areas, of various shapes were designed and constructed with bituminous plant mix material. This construction consisted of applying on the surface of the pavement raised, rounded strips, 9 inches wide and 2 or 3 inches high.

RAISED BARS USED

These strips were in some cases supplemented by raised bars placed within the neutral area and outlined by plant mix strips. These were usually placed to restrict the width of exits on the "Off" ramps so as to limit the travel area to one lane for offbound traffic only.

The creation of these neutral areas also provided a location in many instances for "Stop" signs where better visibility would be afforded, and also the placement of "One Way-Do Not Enter" signs in a more prominent location.

These neutral areas took various shapes and were installed only after exhaustive tests on the ground to determine exactly where they should be constructed for the proper warning and control of traffic. The plant mix bars and strips are painted alternately black and white and are very conspicuous.

GLASS BEADS

In addition, at some locations where it was deemed advisable, spherical glass beads were sprayed onto the wet painted surfaces and these at night reflect considerable light and outline the restricted areas in strong relief. The great advantage of this type of construction is that it is inexpensive to install and to remove or revamp if studies show that there is need for doing so.

The public reaction to these corrective measures has been quite favorable, and the results are being closely watched.

State of California

CULBERT L. OLSON, Governor

Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets Sacramento

FRANK W. CLARK, Director of Public Works

ROBERT H. ROOT, Assistant Director

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Defense Highway Program in California Reached Total of $52,880,000 August 1, 1942

By C. H. PURCELL, State Highway Engineer

ACTIVE preparation by the Division of Highways for defense highway construction in California began in the Summer of 1940. On the basis of the strategic network of highways designated by the War Department as of military importance and of roads requested by the Army, Navy and Marine Corps for access to military and naval cantonments, fields, bases and stations, work on preliminary surveys and plans was started nearly two years ago.

Acting under authority of amended Federal aid regulations, the State financed the preliminary engineering on access road projects and certain proposed improvements to the strategic network with Federal aid secondary and Federal aid funds. Under this procedure the Division of Highways was enabled to prepare programs for defense highway construction.

$45,000,000 PROGRAM

By the time the United States entered the war, the designated access road program included projects to the total value of nearly $45,000,000. Funds for the construction of access road projects were authorized under the National Defense Highway Act of 1941, approved on November 19, 1941. The total sum of $150,000,000 was provided by this act for access road construction throughout the Nation.

On February 1st of this year, plans and specifications had been completed on nearly $25,000,000 in access road projects in California and the Division of Highways was prepared to begin calling for bids on the program as soon as Federal certification for construction of individual projects was received.

The first certification for construction of an access road project was received late in January and bids were opened for this first certified project on February 18th. Since that time, work in getting construction under way has steadily progressed. During the same period, needed improvements to the Strategic Network have been advancing.

Report on Defense Highway Program Under Gov. Olson

Governor Culbert L. Olson has received a report from Director of Public Works, Frank W. Clark, covering defense construction by the Division of Highways, of the Department of Public Works, under Governor Olson's administration.

The report, made by State Highway Engineer, Charles H. Purcell, states that the defense highway program throughout California reached a total of $52,880,000 on August 1, 1942.

This figure, the report states represents work placed under construction, projects advertised for bids, pending advertisement and wholly or partially prepared. This amount includes work in connection with access road construction in the sum of $43,146,600; strategic highway network improvements to the value of $7,576,400 and $2,157,000 for the building of emergency flight strips adjacent to highways.

The complete report giving many interesting details is printed herewith.

ACHIEVEMENT TOTALS $52,880,000

On August 1st, the total accomplishments by the Division of Highways in the defense program are represented by the amount of $52,880,000 in work placed under construction, projects advertised for bids, pending advertisement and wholly or partially prepared. This amount includes work in connection with access road construction in the sum of $43,146,600; strategic highway network improvements to the value of $7,576,400; and $2,157,000 for the building of emergency flight strips adjacent to highways.

While the surveys, plans and specifications for these projects were prepared in advance of the receipt of certification by the War Production Board and approval by the Public Roads Administration, getting the work under way has not been simply a matter of advertising for and opening bids.

Many of the projects, particularly structures, were originally planned under standard designs before scarcity in certain materials became too critical and the status of highway construction in the priority set-up was definitely determined. As the situation clarified and it became apparent that such construction materials as bar reinforcing steel, structural steel, and metal pipe were unobtainable even with relative high priority ratings, changes in the design of structures included in some projects became necessary.

Timber has replaced reinforced concrete and steel girders for bridge construction; mass concrete piers and abutments are used in lieu of reinforced concrete; metal pipe culverts are out entirely, with unreinforced concrete arch culvert sections, wooden boxes and unreinforced concrete pipe taking their place. These required changes have necessitated the best efforts of the Division of Highways engineering staff in pushing the work along so that the revision in design would not result in delaying construction.

With the limitations placed upon normal highway construction activities through Federal control of materials by priority preference requirements, construction operations on the

(Continued on page 11)

New surfaced road through Warthan Canyon swings high above creek bed avoiding a dangerous crossing of ravaging stream

"Sea Going Bridges" No Longer Needed On Realigned Warthan Canyon Highway

By R. S. BADGER, District Construction Engineer

Realignment by-passes this washout of culvert and bridge

STATE Sign Route 198 starts at San Lucas on U. S. Route 101 and winds through the Coast Range to Coalinga and its oilfields, en route across the San Joaquin Valley through Hanford, Visalia, Lemon Cove and Three Rivers to Sequoia National Park. The portion of this route lying between the Fresno-Monterey County Line and Coalinga, includes a sinuous road following Warthan Canyon.

There have been discussions as to the correct name of this creek. Many call it "Wartham" and the U. S. Geological map incorrectly used "Waltham." However, historians have proved beyond doubt that the name should be "Warthan."

The greater portion of the road through this canyon was taken over by the State from Fresno County and has not been built to modern standards. Here Nature has evidenced almost a contemptuous attitude toward man's puny efforts to protect his holdings through the canyon. An outstanding example of this is her treatment of highway bridges and other stream crossings. Through the years man's carefully placed pipe culverts or wooden bridges have been blocked, washed out or floated away. In fact this "floating away" was so frequent that the State's maintenance forces had attached cables to the bridges, anchoring them to trees in order that the decks might be saved when the bridges washed off of their abutments. Mr. T. H. Dennis, State Maintenance Engineer, aptly termed them "The Sea Going Bridges."

It has long been the dream of the people, who depend on this road for frequent passage through the canyon, that some solution would be found for this distressful condition, which was an annual, if not more frequent occurrence in periods of heavy storms. One might say the solution is still well out of sight, as extensive construction is necessary before the whole road can be relocated along lines which conform to comfortable modern standards.

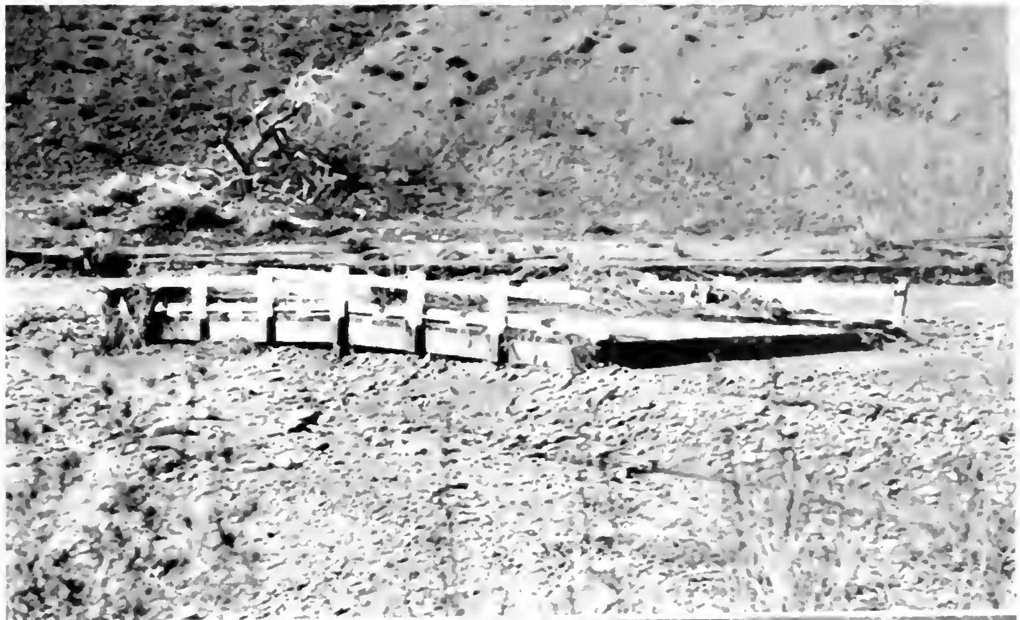
However, one short section has now been relocated and snatched from the threatening grasp of the stream. This section, beginning at a point some quarter mile west of Parkfield Junction, extends easterly about 1¾ miles. In this short distance it eliminates six former crossings of Warthan Creek and incidentally has greatly improved the alignment.

Culvert headwalls and drop inlets were constructed of a moderately hard sandstone, found on the job and which was the most suitable material within many miles.

Practically all of the grading was done with bulldozers, scrapers and scarifiers.

A "stage construction," necessitated by lack of sufficient funds to construct a higher type surfacing, still provides a roadbed width of 26 feet and a 5 inch surfacing of local gravels, oil-mixed with SC-3 to a depth of 2 inches.

The pictures accompanying this article indicate some of the past difficulties in maintaining stream crossings and show the new road, well removed and protected from damage by Warthan Creek.



Above—"Sea-going" bridge anchored by cable. Below—Typical road washout

The improvement is highly appreciated by the local residents and others who use this route frequently.

Harms Brothers were the contractors and Richard Windele was resident engineer.

Necessity Auto Use Totals 274 Billion Passenger Miles

A recent survey revealed that, in an average year, the Nation's automobiles run up a total of [illegible],000,000,000 passenger miles. Of this, more than 50 per cent is for purposes classified as "necessity" driving. This means that there is a total of about 274,000,000,000 passenger miles of necessity automobile use that can not be eliminated without seriously disrupting the entire transportation picture.

For example, workers in many defense plants throughout the Nation are largely dependent on passenger cars for getting back and forth to work. Approximately 2,320 cities with a total population of more than 12,500,000 are without local mass transportation systems and are, therefore, completely dependent on automobile transportation.

There are more than 45,000 communities with no railroad transportation and six States with no street cars. There are 18,000,000 people who work in the city but live in rural areas and most of them must travel by automobile to get to their work.

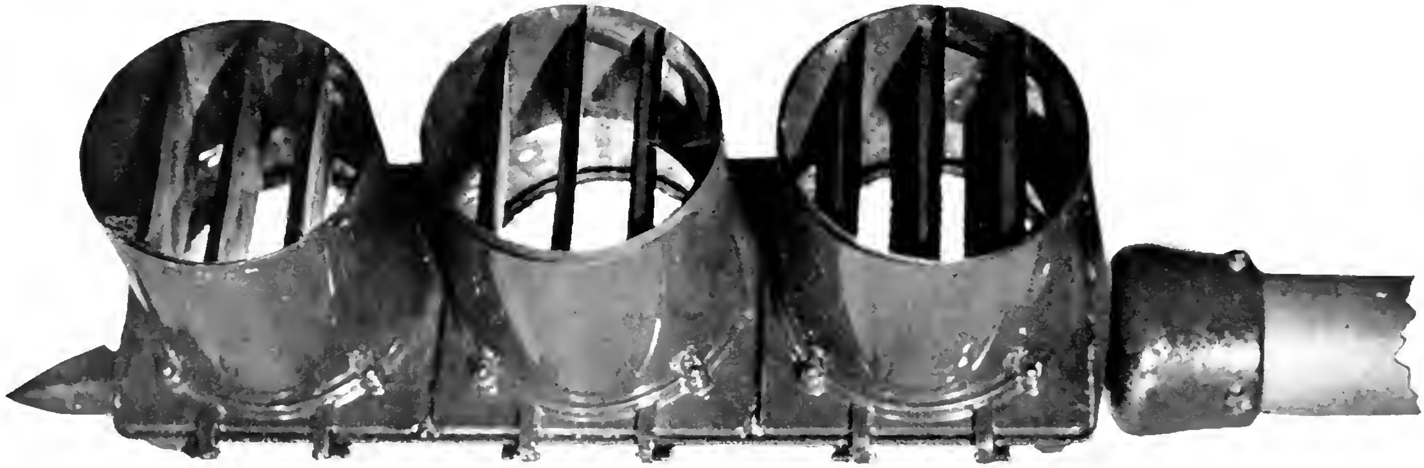
Highways Division Designs New Traffic Signal Blackout Unit

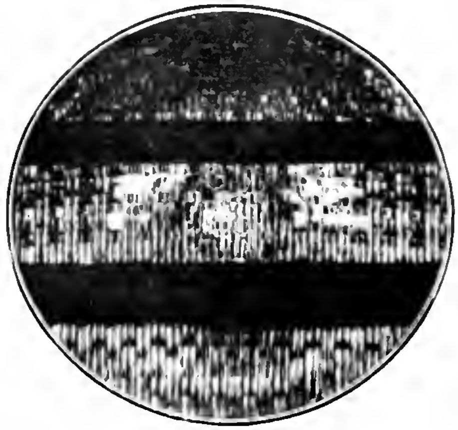
By A. E. SIMMONS, Assistant Highway Engineer

SINCE the first blackout was ordered there has been an urgent demand for a satisfactory method of controlling traffic signal lights so that the light from the signals could not assist enemy airmen to find their targets. Such a device has now been developed by the Division of Highways of the Department of Public Works and ordered installed on all State Highway signals.

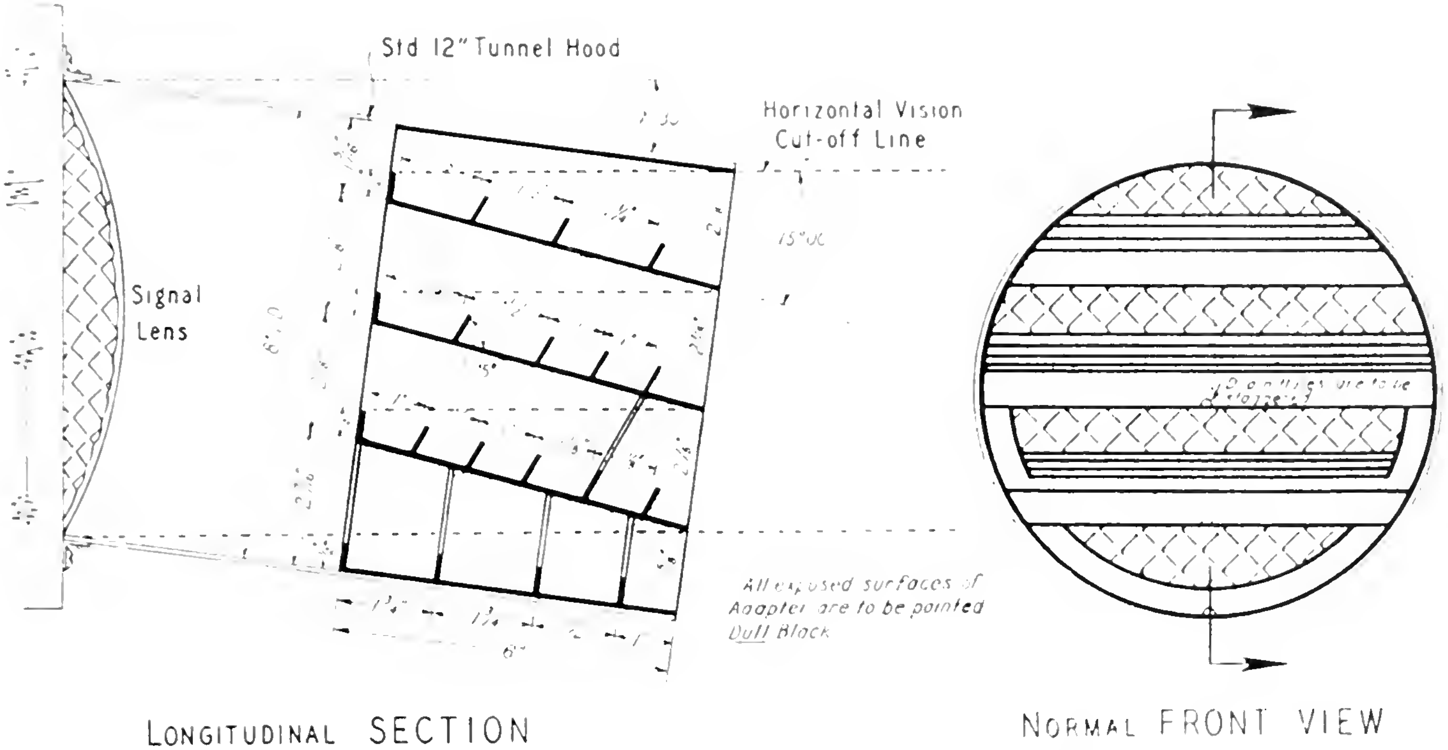
A number of methods had been tried, but none had proved completely satisfactory. In London, for instance, the signal lenses were painted black with the exception of a small cross $\frac{1}{8}$ inch x $1\frac{1}{2}$ inches. At night this cross gave sufficient indication to traffic and satisfied blackout regulation, but during the daytime the small cross of light was not visible to the motorist, and consequently was a definite traffic hazard. Los Angeles, in trying to overcome the daytime faults of the London Cross, enlarged the cross dimensions to $\frac{7}{16}$ inch x 5 inches. While this enabled the cross to be seen in the daytime, at night there was so much light coming from the signals that blackout requirements were not satisfied.

At the warning for a blackout, some communities detailed a man to each signalized intersection to turn off the signals. While this method was effective from the standpoint of blackout control, it required the use of men who would be needed for other duties in case of an actual air raid. Then, too, it was desirable to retain some form of traffic control for the emergency vehicles that would be traveling without headlights during the blackout. With the traffic lights turned out there was no traffic regulation at all during the blackout, and in certain instances a great deal of





Upper—Typical installation of signal blackout unit. Lower left—View of blackout unit. Lower right—Closeup view of installed unit.



SIGNAL BLACKOUT UNIT

confusion and some accidents occurred at congested intersections.

MEETS HIGH SPEED TRAFFIC

What was really needed for the traffic signals was a device that could be easily and permanently installed and would completely shield the signal light from enemy airmen, and at the same time give an adequate signal indication to traffic during night and day. Therefore, a study was undertaken by the Division of Highways to develop a satisfactory signal blackout unit that would meet the requirements of military authorities and modern high speed traffic.

The inspection of a signal installation readily showed that the signal light visible to an enemy airman came from the lens itself, from signal light reflected off the visor or hood surrounding the lens, and from signal light reflected from the street.

A conference with military officials indicated that satisfactory blackout control would exist if all direct signal light from the lens and all reflected light from the hood or visor surrounding the lens were cut off above a plane level with the signals, and if reflected light from the street pavement was reduced to an amount visible not more than one-quarter mile.

The problem was to satisfy the above conditions and at the same time maintain an adequate signal indication for highway traffic at all times.

EFFICIENT DESIGN

A type of louver seemed to fit the requirements providing the light reflected from the top of the vanes could be eliminated. By inserting fins on the top of each vane and adjusting the fin height and spacing so that a series of shadows were developed on the top of the vanes, the problem was solved.

The design developed is so efficient that all the light from the signal (using a standard 60 watt traffic lamp at full brilliancy) was cut off within a vertical distance of five feet when viewed 500 feet from the signal.

The unit is cylindrical, being eight inches in diameter and six inches long and having three central vanes, and is intended for use in the end of the 12-inch tunnel hoods which are standard equipment on west coast signal installations.

The vanes occupy approximately 40 per cent of the lens area, leaving a maximum exposed lens area of 60 per cent. The actual amount of lens area visible to traffic will vary from this maximum amount, depending upon the signal mounting height and the distance from the observer.

DIFFUSION OF LIGHT

The unit shown is designed for use in signal hoods having the standard downward tip of 7½ degrees. For use in other hoods it would be necessary to alter the design in order to secure the horizontal cut off plane.

When viewed from a distance there is very little restriction of the signal indication. Most observers can not distinguish any reduction in signal intensity. This, of course, is due to the diffusion of the signal light around the vanes.

At a short distance the signal indication appears as three or four bands of light and due to the fact that these light bands are at full signal brilliancy they are entirely adequate under day and night conditions. A traffic signal installation consisting of signals on the far right hand corners and a four-way center suspended signal has been equipped with these blackout units and has been in operation for several months. Night observations have been made by officers of the Army and Navy for the purpose of checking the effectiveness of the blackout unit and their reports are indeed very satisfactory.

(Continued on page 20)

Establishing The Oil Content For Dense Graded Bituminous Mixtures

By F. N. HVEEM

This is the second and concluding installment of an article by F. N. Hveem, Senior Physical Testing Engineer, Materials and Research Department, Division of Highways, on "Establishing the Oil Content for Dense Graded Bituminous Mixtures."

ANY design or type of centrifuge can be used which will handle samples weighing 100 grams (with centrifuge cups approximately two inches inside diameter) and which can be operated at a speed subjecting the sample to a force of 400 times gravity. In view of the relatively low speed required, the operation is entirely practicable for a hand-operated centrifuge which can be readily carried into the field for control testing. The equipment used here was secured from the Emil Greiner Company, 161 6th Avenue, New York, catalog No. CE-8535. A safety dome cover is required in order to develop the necessary speed and prevent spattering of the kerosene. With this particular centrifuge the necessary force can be developed by turning the handle approximately 45 revolutions per minute. If other equipment is used, the radius of the centrifuge arm to the center of the sample can be calculated as follows:

$r \times (\text{RPM})^2 = 14{,}000{,}000$

Where r = radius in inches to center of gravity of soil sample

RPM = revolutions per minute of centrifuge head.

See photograph, **Figure IX**, which shows the complete centrifuge and special head and cup assembly.

CENTRIFUGE KEROSENE EQUIVALENT

The procedure is as follows:

1. Secure a representative dry sample of aggregate and by sieving determine the percentage by weight of the material passing the U. S. Standard No. 4 sieve.
2. Place exactly 100 grams of the dry aggregate passing the No. 4 sieve in a tared centrifuge cup fitted with a screen on which is placed a disk of filter paper.
3. Place the bottom of the centrifuge cup in kerosene until the aggregate becomes saturated.
4. Centrifuge the saturated sample for two minutes at a force of 400 times gravity.
5. Weigh the sample after centrifuging and determine the amount of kerosene retained as per cent of dry aggregate. This value is called the Centrifuge Kerosene Equivalent abbreviated to C.K.E.).
6. If the specific gravity of the aggregate is appreciably different from 2.65, apply a correction to this C.K.E. according to the scale at the bottom of the chart, Figure III, Scale "E."
7. Using this corrected C.K.E. and per cent aggregate passing No. 4 sieve, the indicated oil ratio may be obtained from the alignment chart, Figure III, Scales "A," "B," and "C."
8. The oil ratio determined under 7 is the required oil ratio for the combined fine and coarse aggregate, applying to liquid asphalts having a viscosity range of 100 to 1,000 seconds Saybolt Furol at 140° F.

This method is simple and the operation can be carried through in 15 minutes or less and has been given a thorough trial for the past year by field engineers in California. Correlation between the Centrifuge Kerosene Equivalent and the oil content (found to be satisfactory on the road) is excellent, being accurate in at least 95 per cent of the cases.

If this procedure is used by the resident engineer or superintendent to control the oil content of the work during construction, the foregoing procedure appears to be adequate; however, when the C.K.E. values are determined in a central laboratory as a basis for oil content recommendations to the field engineer, it is then desirable to classify the aggregate in terms of appropriate surface factors in order that the field engineer may apply the necessary corrections due to changes in grading as indicated by surface area calculations. For this purpose chart, **Figure V,** is furnished which permits the assignment of a surface constant K_f from the C.K.E. As indicated by the development of equations (f) and (g), the value of K_f may be taken as equivalent to K_m and thus represent the entire aggregate in a large majority of cases; however, certain instances may arise wherein the coarse aggregate is of markedly different character than are the fines used in the C.K.E. determination, and some correction may be necessary to arrive at a composite surface factor representing the combined coarse and fine aggregates. For this determination the coarse aggregate must also be classified and given a surface constant designation (K_c).

AGGREGATE ABSORPTION TEST

A representative sample of dry coarse aggregate weighing 100 grams passing the $\frac{3}{8}$ inch and retained on the No. 4 sieve is placed in a glass funnel of approximately 4 inches diameter. Sample and funnel are submerged in a beaker containing light lubricating oil, grade S.A.E. No. 10, for five minutes at room temperature. The funnel is then lifted and the oil permitted to drain for 15 minutes while the sample is maintained at a temperature of 140° F. The sample is then weighed and the percentage increase in weight due to oil absorbed or retained on the surface is noted. This value is referred to the chart, **Figure VI**, and converted to the surface constant K_c.

After having determined the surface constant K_f for the fine aggregate and K_c for the coarse aggregate, it is then necessary to compute the value of K_m for the given combination of fine and coarse. When the coarse and fine materials are all of the same type, the values of K_c and K_f should be identical when determined by the methods described above. When the two values are markedly different, by reference to chart, **Figure VIII**, it is possible to arrive at the value of K for the composite mix by using the surface area calculated from sieve analysis of the combined aggregates and the percentage of material retained on the No. 4, together with the values (K_c-K_f). As noted on the chart, K_m is calculated by applying the indicated correction to K_f. If the value of K_c-K_f is negative, the correction will be negative; if the value of K_c-K_f is positive, the correction will be positive.

THE FORMULA

In other words, if, for example, the coarse aggregate were appreciably more absorbent than the fine materials, it is obviously necessary to increase the value of K for the combined mix over the value indicated for the fines alone. When the value of K_m is thus determined, reference may be made to the chart, **Figure III**, on which the corrected oil ratio may be reached by using the calculated surface area, the average specific gravity of the aggregate, and the value of K_m (Scale D to Scale B).

All of the foregoing methods have been designed to give the oil ratio requirement for use with the more fluid grades of the liquid asphalt; for example, grades SC-2 and 3, MC-2 and 3, or others of similar viscosity. If heavier grades are used, for example SC-5 or 6 or paving asphalts of varying consistency measured by penetration, it is usually necessary to increase the estimated quantity in line with the increasing absolute viscosity.

Thus far we have been unable to develop a universally successful method for applying this correction to all grades of asphalt for all construction conditions and types of aggregate, and it is evident that further work is required on this phase of the problem. However, a tentative method has been established to indicate

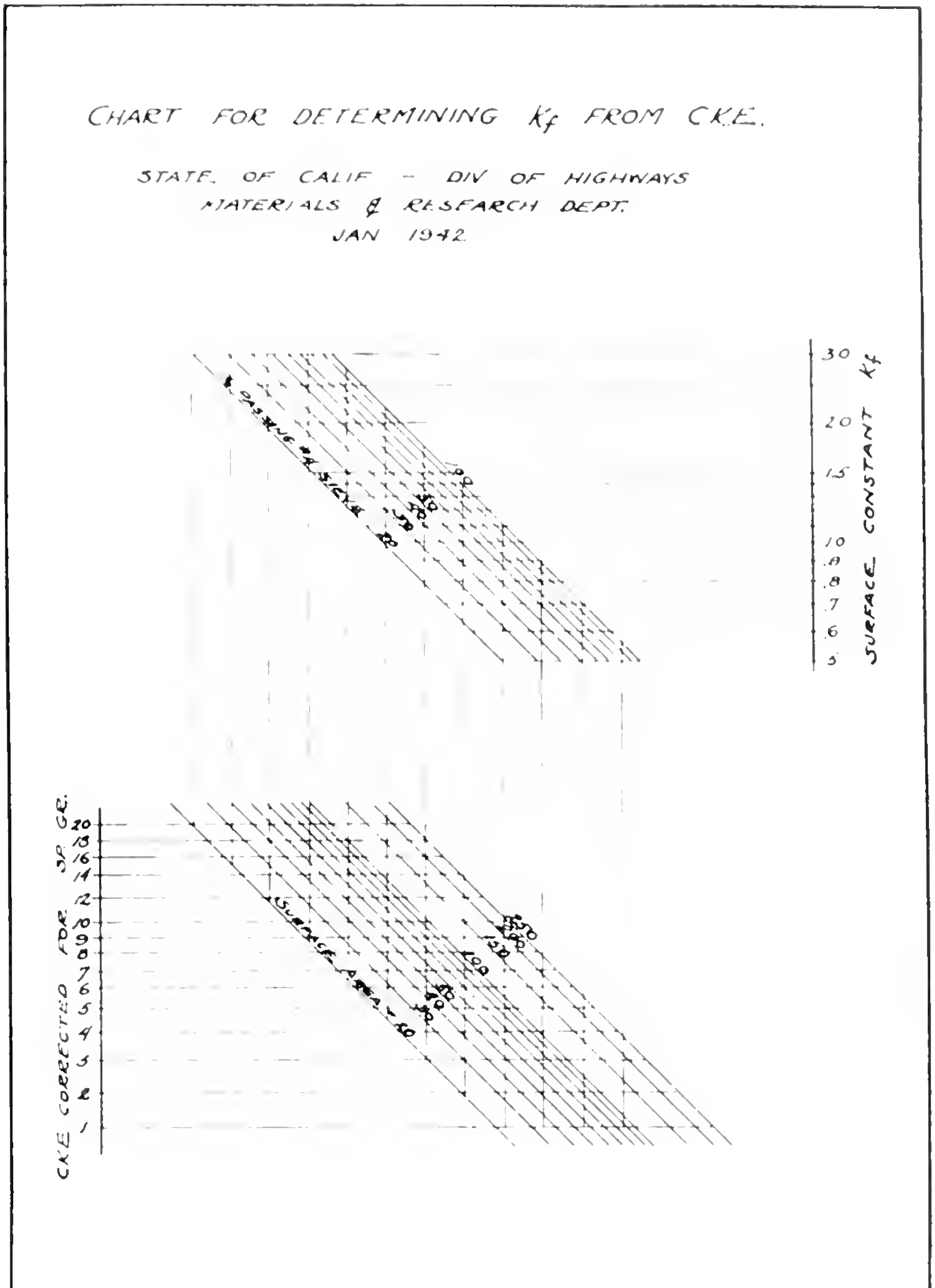


FIG V

direction and magnitude which is reasonably satisfactory and may be used as shown on chart, **Figure VIII**, with the admonition that complete dependence can not be placed on the results whenever the aggregates are highly absorbent, contain unusual quantities of fine dust, or have a very low voids ratio. It is, of course, evident that whenever the voids in the mixture are quite low and the surface capacity is high, a point is often reached where the quantity of asphalt calculated to cover the surfaces becomes greater than the void volume in a particular combination. Regardless of other considerations, the volume of asphalt must be maintained safely below the volume of the voids in the aggregate. Whenever the values of K_m are approximately equal to 1.0 (in other words, an average aggregate) this correction may be applied with considerable confidence. Whenever

K_m is greater than 1, indicating absorbent aggregate, it then appears that the heavier asphalts are not necessarily absorbed to the same degree as are the lighter oils and cutbacks. This condition may reach a stage where no increase of asphalt can be made in line with increasing viscosity. With these precautions the chart, **Figure VIII**, may be used to indicate a correction to the oil ratio previously estimated either by the surface area calculation or by the centrifuge kerosene equivalent method above described.

On chart, **Figure VIII**, by means of a straightedge connect the values on scale A (which represent grade of oil to be used) with values on scale B, representing the calculated surface area of the combined aggregate. Through the point of intersection on line C place a straightedge connecting with the previously determined oil ratio value on scale D. The intersection of the straightedge with scale E represents the oil ratio corrected for viscosity or consistency of the asphalt.

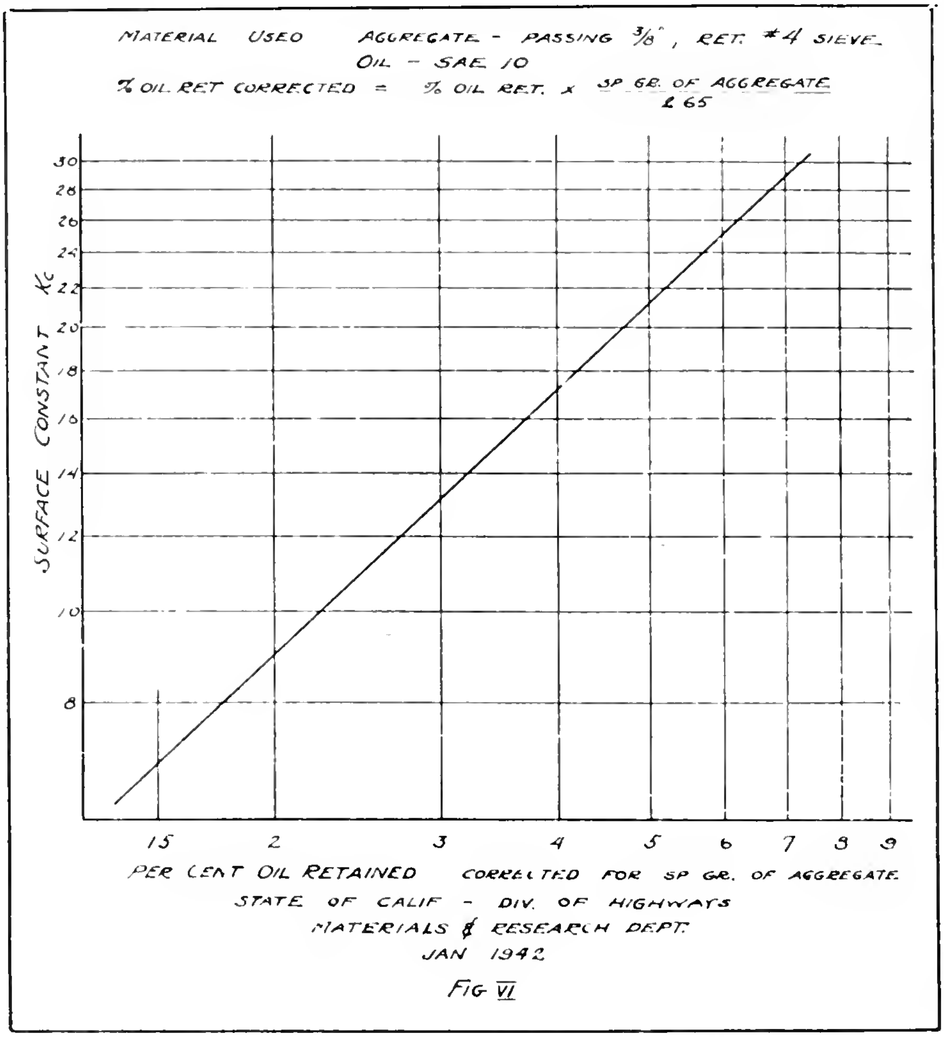
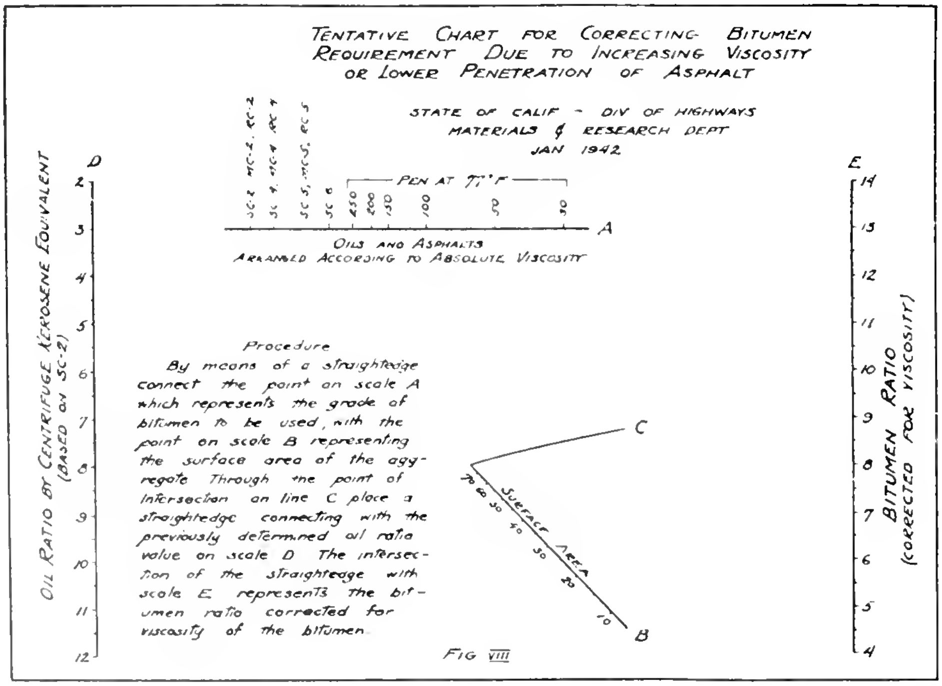


Chart for determining Kc from coarse aggregate absorption

APPLICATION OF METHODS

Case I. In which it is desired to determine the optimum oil ratio (Grades 2-3-4) for an aggregate whose characteristics do not change abruptly on the No. 4 sieve size. This is the most usual case and applicable to all road mix construction with local material, e.g.



(1) By screening determine the per cent by weight of aggregate passing the No. 4 sieve.

(2) Determine C.K.E.

(3) If the specific gravity is less than 2.4 or greater than 3.0 correct the C.K.E. by adding or subtracting the amount determined from the bottom of Figure III, Scale E.

(4) From the per cent of aggregate passing the No. 4 sieve and the corrected C.K.E. the oil ratio may be determined from the alignment chart, Figure III, Scales A, B, and C.

Case II. In which it is desired to find the optimum oil ratio of a fine aggregate having certain surface characteristics combined with a coarse aggregate of different surface characteristics. This is more complicated than Case I, but perfectly general.

(1) From the wash grading calculate the surface area according to the method of Stanton and Hveem.

(2) Determine the C.K.E. by the method described.

(3) Correct C.K.E. for specific gravity of the fines by the following formula:

$$\underset{\text{(Corrected)}}{\text{CKE}} = \underset{\text{(Uncorrected)}}{\text{CKE}} \times \frac{\text{Sp. Gr. fine}}{2.65}$$

(4) Using this $\text{CKE}_{\text{(Corrected)}}$, the surface area and per cent by weight of aggregate passing the No. 4 sieve determine the surface constant K_f by the use of Figure V.

(5) Determine K_c by the method described. **Figure VI.**

(6) Determine K_m by the use of **Figure VII.**

(7) Using the surface area, average specific gravity of the total mix and K_m, the optimum oil ratio for the total mix is then determined by the use of **Figure III**, Scale D to B.

Note: Theoretically there should be a correction applied to the surface area and per cent of aggregate passing and retained on the No. 4 sieve due to the difference in specific gravity of the coarse and fine. The effect of these corrections is small and partly compensating so that they may be neglected.

Example No. 1—Unblended soil for Road Mix Surface Treatment.

Data:

Per cent passing 24 sieve = 70%
Specific gravity, coarse = 2.4
Specific gravity, fine = 2.6

$$\text{Specific gravity mix} = \frac{1}{\frac{.30}{2.4} + \frac{.70}{2.6}} = 2.54$$

C.K.E. = 5%

(1) From Figure III, Scales A, B, and C Oil Ratio = 5.6%

Note: If the C.K.E. had been corrected for specific gravity of the aggregate, the corrected C.K.E. would have been 5.1% and the oil ratio 5.7%. This small variation in calculated oil content is ordinarily not significant as a range of 0.1 per cent is less than the normal error in construction proportions. Few mixtures are critical within 0.1% either above or below the theoretical optimum.

Example No. 2—Blend of hard dense river gravel retained on No. 4 sieve with quite absorptive fine material passing No. 4 sieve.

Data:

Specific gravity, coarse = 2.65
Specific gravity, fine = 2.25
Per cent coarse = 50%

$$\text{Specific gravity mix} = \frac{1}{\frac{.50}{2.25} + \frac{.50}{2.65}} = 2.43$$

Surface area mix = 45 square feet
C.K.E. = 11.8
Per cent oil absorbed by coarse = 1.5%

(1) $\underset{\text{(Corrected)}}{\text{C.K.E.}} = \frac{11.8 \times 2.25}{2.65} = 10.0$

(2) Figure V, K_f = 1.8

(3) From Figure VI, K_c = 0.7

(4) From Figure VII, Corr. = −0.3
K_m = 1.8 + corr. = 1.8−0.3 = 1.5

(5) From Figure III, Oil Ratio = 7.2%

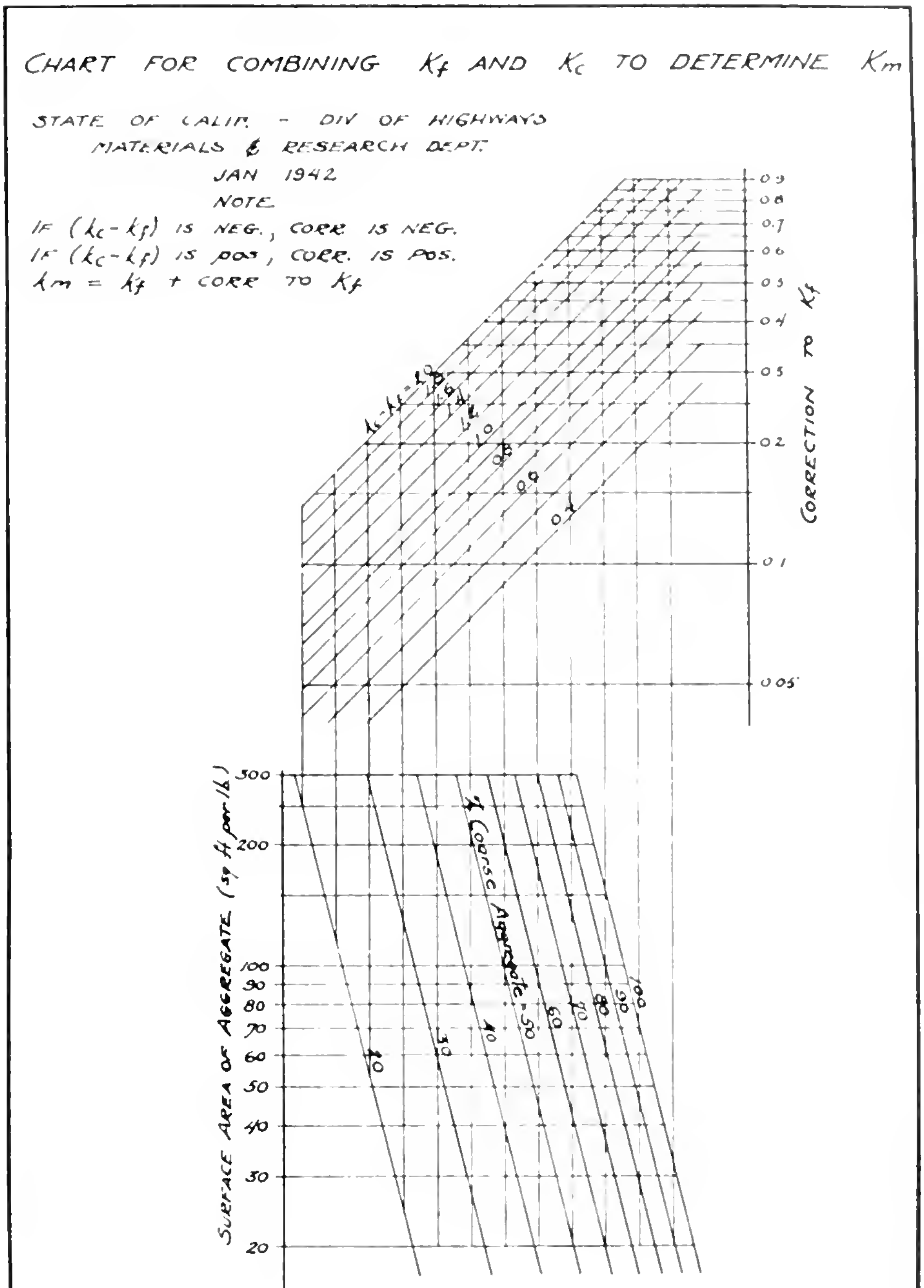
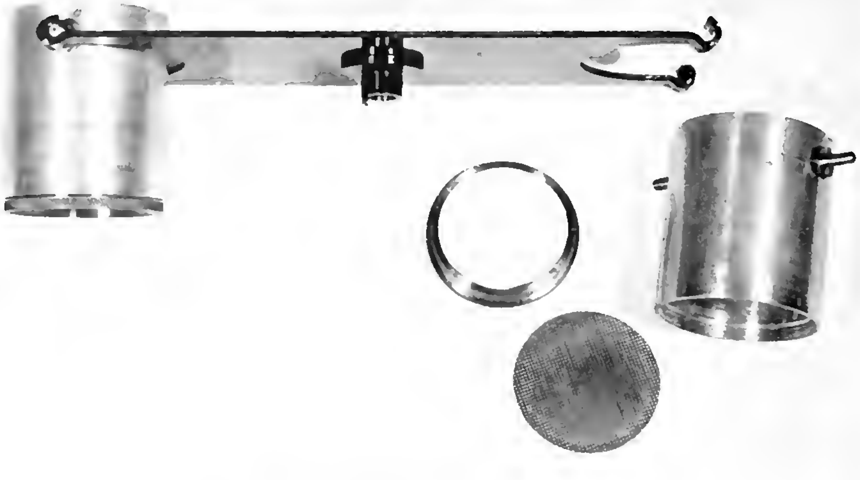


FIG VII

Assuming that it is desired to use an oil heavier than SC-2 or MC-2, say SC-6, taking Example No. 2 with oil ratio of 7.2 and referring to chart,



CENTRIFUGE KEROSENE EQUIVALENT APPARATUS

FIGURE IX

Figure VIII, it will be indicated that the quantity will be 7.4; however, as K_m is 1.8, caution must be exercised as the rate of absorption with a heavy oil will probably be so slow as to cause temporary instability on the road.

Taking a case for hot mix plant construction with a graded aggregate having 35 sq. ft. surface area and $K_m = 1.0$ oil ratio calculated at 4.2%, it will be found from chart, **Figure VIII**, that SC-2 will require 4.2%, SC-6 4.7%, 150 penetration asphalt 5.1%, 55 penetration 5.5%. These relative amounts have been used and found suitable in actual practice.

While the foregoing discussion of corrections and special cases may seem to be somewhat involved and complicated, in actual practice the kerosene contrifuge equivalent determination may be performed quickly and is sufficiently accurate except for a few special cases (see correlation on **Figure IV**). There will, of course, remain a few instances wherein no method short of an actual stability test on trial mixes will be adequate. This is due to the fact that any relationship between stability and absorption of a standard liquid or surface measurement calculation is largely fortuitous as in the final analysis the upper limit of permissible asphalt content depends on the degree of lubrication and this can only be positively determined by some test measuring the internal friction of the compacted mass.

All of the foregoing data apply to California asphalts and it should be realized that in using asphalts possessing a more distinct structure, such as Mexican asphalt, for example, the final values indicated herein may need to be increased over the quantity found sufficient for the more truly liquid California product.

In conclusion, the writer wishes to acknowledge the efforts of Mr. Ernest Zube who was responsible for much of the experimental work and to Mr. Robert Carmany who assisted in making the large number of correlation tests and who analyzed the data and developed the mathematical relationships necessary to construct the essential curves and charts.

Errata—In the previous installment of Mr. Hveem's article printed on page 17 of the July issue, the last equation (a) should read:

EQUATION (a)

$$\text{Oil Ratio}_{mix} = \frac{(0.85\,\text{C.K.E.} + 2.5)\,.0067\sqrt{SA_{mix}}}{100 \times .0067\sqrt{\dfrac{SA_{mix} \times 100}{\%\ \text{passing No. 4}}}}$$

Simplifying:

$$\text{Oil Ratio}_{mix} = \frac{(0.85\,\text{C.K.E.} + 2.5)}{100}\sqrt{\frac{\%\ \text{passing No. 4}}{100}} \qquad (g)$$

1941 Cement Output Largest

During 1941 cement production in California amounted to 19,531,608 barrels, valued at $26,248,694 f.o.b. plant, of which 10,281,489 barrels came from plants in northern California and 9,250,119 from southern California plants. This was the largest output as to amount recorded in the State and was only exceeded in value in 1927. The 1940 output amounted to 13,955,255 barrels, worth $17,673,202.

Shipments during 1941 were made by 12 plants in 11 counties to the extent of 19,833,796 barrels, valued at $27,219,800, as compared with 13,545,306 barrels, worth $17,195,105 shipped in 1940. During 1941 there were seven plants operating in northern California and five plants in southern California. There was an average of 2,790 men employed in the above mills during the year.

Defense Highway Program in California Reached $52,880,000

(Continued from page 1)

State Highway System have to some extent been curtailed; however, the Division of Highways has, at the same time, lost some 300 men to the armed forces and to construction connected with defense industries. This condition has made most difficult concentrated work on the defense highway programs by the available engineering personnel of the department. Nevertheless, even with a depleted staff, the work has proceeded rapidly.

The progress that was made during the first seven months of 1942 in advancing this phase of the war effort is reflected by the following analysis of the status of California projects on August 1st.

ACCESS ROADS	No. of Projects	Miles of Improvement	Bridges	Grade Separations	Amounts	Totals
Projects Certified	67	218.7	22	10	$19,794,500	
Certification Pending	11	54.1			3,109,100	
Subtotals	78	272.8	22	10		$22,903,600
Contracts Awarded	42	119.8	14	7	$12,400,600	
Day Labor Projects	1	33.4			210,000	
Projects Advertised	1	3.0	1		1,347,000	
Projects Pending Advertisement	4	19.0		1	821,500	
Subtotals	48	175.2	15	8	$14,779,100	
9 projects prepared by the Division of Highways built under supervision of the Army, Navy, or WPA						2,643,000
7 access road projects being financed with State and Federal Aid funds						3,100,000
9 projects prepared at request of military but for which certification has been deferred by War Department						14,500,000
Total Access Program						$43,146,600

STRATEGIC NETWORK	No. of Projects	Miles of Improvement	Bridges	Grade Separations	Amounts	Totals
Projects Certified	31	109.6	13	1	$5,836,800	
Certification Pending	4	12.7			1,325,000	
Subtotals	35	122.3	13	1		$7,161,800
Contracts Awarded	15	67.2	8		$2,149,000	
Projects Advertised	1	3.9			420,000	
Projects Pending Advertisement	8	20.3	3		1,448,000	
Subtotals	24	91.4	11	1	$4,017,000	
In addition to the above, 4 projects were certified, advertised and bids rejected as excessive. Decision as to revision and readvertising is now pending						414,600
Total Strategic Network Program						$7,576,400
FLIGHT STRIPS						
4 projects certified, and contracts awarded						$2,157,000
Total Defense Highway Work						$52,880,000

While the location of military establishments has resulted in concentration of construction projects in certain areas, the program as a whole is quite widespread throughout the State. For obvious reasons, the definite locations are not given of this defense work, however, the following breakdown of the foregoing tabulation to various sections of the State shows the distribution throughout California of access road projects and improvements to the strategic network.

	ACCESS ROADS		STRATEGIC NETWORK	
	Projects Certified & Pending Certification	Contracts Awarded, Projects Advertised & Pending Advertisement	Projects Certified & Pending Certification	Contracts Awarded, Projects Advertised & Pending Advertisement
"A" Area				
Number of Projects	18	11	10	5
Miles	61.2	32.0	29.7	15.7
Bridges	2	1	2	1
Grade Separations				
Amount	$5,898,400	$3,442,400	$2,000,900	$611,900
"B" Area				
Number of Projects	15	11	6	6
Miles	61.6	47.9	45.4	45.4
Bridges				
Grade Separations				
Amount	$5,350,600	$4,360,600	$1,233,400	$1,233,400

(Continued on page 15)

View of completed surface on the Feather River Highway in scenic region between Howells and Keddie

Recent Highway Improvements In Feather River Area Total 70 Miles

By F. W. HASELWOOD, District Engineer

THE Feather River or North Fork Highway between Oroville and Keddie, costing about $8,000,000, was opened to traffic in August, 1937. It provided a low grade, relatively snow-free route through the Sierras where none had existed before.

In view of the fact that the area it traverses, or through which its tributaries pass, is well served by railroads, prospective traffic was assumed to be light in weight and not so heavy in volume. A light oil treated surface was constructed to serve the anticipated light traffic for about five years.

The Feather River Highway, originally conceived as connecting Oroville and Quincy, two county seats, by way of the North Fork, has now been expanded in the public mind to include the extension of the route from Quincy to Hallelujah at the junction of U. S. 395 about 20 miles from Reno.

OROVILLE-QUINCY UNIT

The country bordering the highway through the canyon of the North Fork and its tributaries is rugged and scenic but is not adaptable to the kind of development that generates traffic. Probably to a maximum degree for transmountain roads, the Oroville-Quincy unit of the Feather River Highway, 78 miles in length, serves through traffic, the nature and volume of which depends to a considerable extent on its tributaries and their state of improvement, as well as on the extent of improvement of the highway itself.

The Quincy-Hallelujah unit of this highway, about 60 miles in length, traverses a country which generates considerable traffic of a recreational as well as of a commercial nature. Commercial traffic consists largely of transportation of logs from the woods to the mills, of timber products from the mills to market and supplies to the mines.

Major tributaries contributing to traffic on this highway are the Sierra Way, U. S. 395, serving all of northeastern California and the Vinton Feeder Road, which serves Sierra Valley adjacent areas and of supplies for the mining areas.

SIERRA-WAY ROUTE

The Sierra Way was conceived by the U. S. Forest Service as a north and south route through the high Sierras extending from near Mt. Shasta to General Grant Park. Much improvement has been made on it by the Public Roads Administration with Forest Highway funds. It joins the Feather River Highway from the north near Paxton and from the south at Blairsden. There are many sawmills on this route, traffic is heavy and the route in this area takes on a commercial rather than a recreational aspect.

Traffic on the Vinton Feeder Road is largely commercial, theoretically terminating at the railroad but actually continuing east or west on the Feather River Highway.

U. S. 395, from the north, contributes to a lesser degree since traffic on this route, as measured at Hallelujah, is primarily of a through nature, consisting of both passenger and heavy commercial vehicles. However, the Hallelujah-Reno branch of this route is an essential extension of the Feather River Highway. Particularly in winter, when snow conditions are unfavorable on other trans-Sierra routes, much heavy traffic is routed over the Feather River Highway to and from Nevada.

The beginning of the current biennium in July, 1941, after the highway through the canyon had been opened

Above—Completed highway near Keddie. Below—load of logs being hauled from mill on another section of new highway for four years, found the volume of traffic to be about half of that predicted by the enthusiastic and optimistic promoters of the North Fork Highway, but twice that of any departmental prediction for the first five years, and entirely different as to weight of vehicles as well as density.

It was not unexpected that the budget, effective July 1, 1941, should provide for strengthening some of the surface applied in 1937 with the expectation of serving the anticipated light weight and light volume traffic for approximately five years.

ECONOMIC PLANNING

In the design and construction of highways there are but few items that can be considered permanent. Right of way adequate for present development and future expansion of the highway acquired on an alignment not subject to future radical change and so laid out as to anticipate possible minor changes, and the grading and drainage structures on a highway constructed on such well-considered alignment and grade may be classed as the most nearly permanent items of a highway.

Following the old theory of not sending a man to do a boy's work, it has not been found economical or possible in view of the vast needs of our highway system to construct surfaces beyond the capacity of the anticipated needs for a period reasonably in advance of the time of improvement. Regardless of whether it is done consciously and voluntarily, highway surfacing is designed and constructed to meet a known or expected specific requirement and is subject to future expansion in thickness, width and number of traffic lanes as the requirements develop and change and thereby follows a definite pattern of stage construction. The policy of stage construction of highway surfacing is therefore universal and economic as well as financially necessary.

STAGE CONSTRUCTION

Those cases where stage construction of alignment and grade can be justified or excused on the ground of expediency are fast disappearing, although there is a vast need for another and final stage of improvement of alignment and grade on a great proportion of our existing highways. Stage construction of alignment and grade is uneconomical in that it results in a loss of all discarded grade or surface, or a write-off of the value of these two items against the traffic using the road up to the time of the further or final stage of improvement.

Analyzing the Feather River Highways and its tributaries as of 1941, when the growing pains of traffic began to be acute, we find roads of all stages and conditions, from total lack of improvement except dust oiling to permanency as to alignment and grade, with stage constructed surfaces having reached or rapidly approaching a state of inadequacy. Between these extremes, and more particularly between Quincy and Beckwourth, stage construction of alignment and grade prevails to an extent that the road is inadequate in many locations for the present traffic.

The implication that the canyon unit of the Feather River Highway is permanent as to alignment and grade is based on the facts that the ruggedness and instability of the country traversed will, except in very few cases, permit nothing more than minor expansion in width on present alignment and grade.

P. W. A. IMPROVEMENTS

In 1941 the Public Roads Administration had made, or had in progress, improvements that would provide permanent alignment and grade—the same factors applying here as in the North Fork Canyon—and stage construction surface between Lake Almanor and the Feather River Highway at Paxton. The improvements in progress would eliminate posted bridges and would release a considerable volume of long distance hauling of timber products. Similar stage construction was underway by the Public Roads Administration on a unit of the Feather River Highway between Keddie and Quincy.

The problem of the 1941 State Highway budget for relief of distress on the Feather River Highway and its tributaries resulted in several well selected improvements which were all additional increments of surfacing, except the seven-mile unit just east of Quincy. This unit provided an additional and possibly final stage of alignment and grade, as well as an improved stage of surfacing.

The improvement of these inadequate highways to the extent that finances could be made available was accomplished or contracted with one minor exception in 1941, before war conditions had too severe an effect on highway costs.

These accomplishments are now briefly described with location, length and cost.

FEATHER RIVER HIGHWAY—HOWELLS TO KEDDIE, 19.9 miles. The existing surface was a penetration and armor over the natural material in the grade. The improvement consisted of a substantial increment of base and a plant-mix 20 feet wide and 3 inches thick. Hemstreet and Bell did the work, in 1941, at a cost of $149,083.

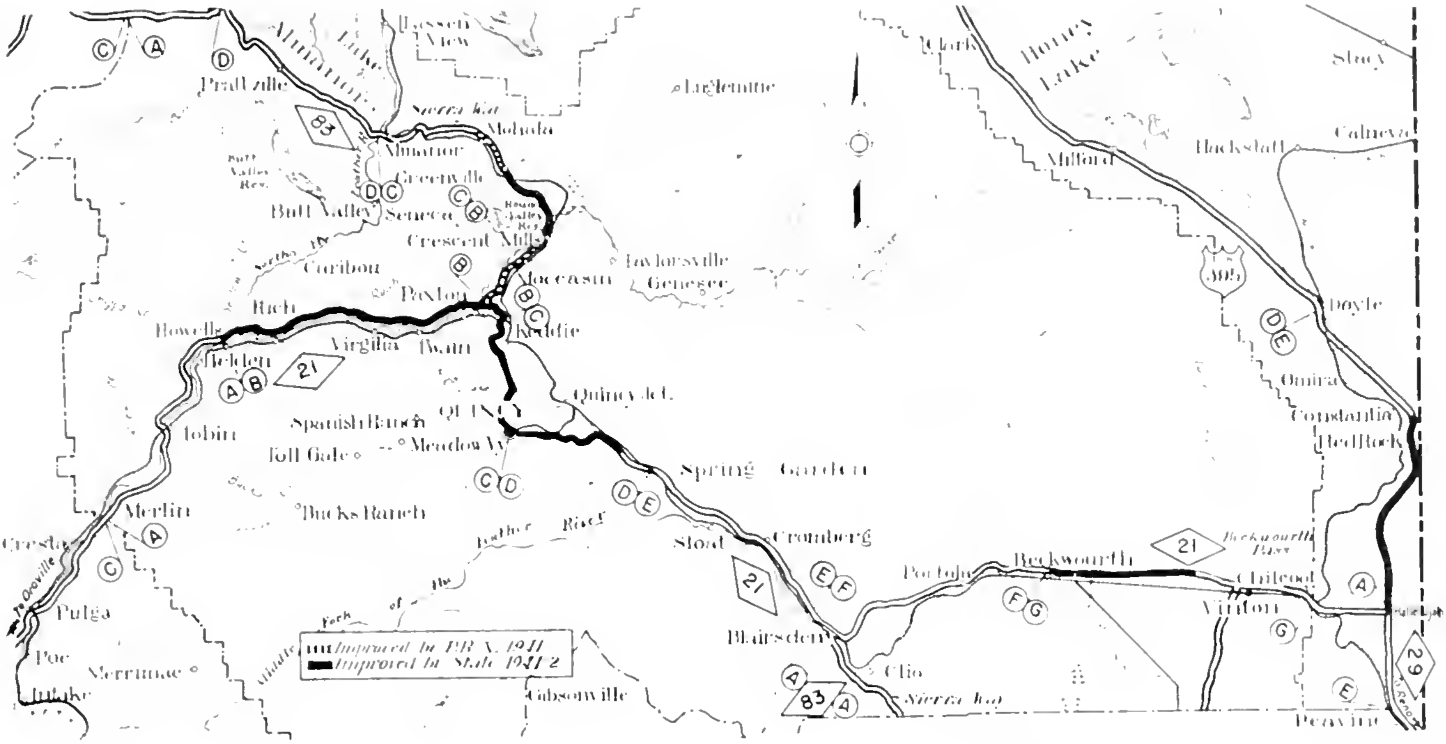
FROM KEDDIE THROUGH QUINCY, 7 miles. The State placed a leveling and reinforcing course of plant-mix over the work completed in 1941 by the Public Roads Administration and over the existing street of Quincy. The thickness varied from one-tenth and the width from 22 feet outside of town to a maximum of 60 feet inside of Quincy. Contract for this work was awarded to Poulos and McEwen in 1942, at a cost of $22,879. The work completed by Public Roads Administration in 1941 between Keddie and Quincy was done by Isbell Construction Company at a cost of $169,559.

FROM QUINCY EAST FOR 6.8 MILES alignment and grade was stardardized and a substantial surface consisting of a gravel base not less than 9 inches thick and a plant-mixed surfacing 2½ inches thick and 22 feet wide. This project was constructed by Harms Bros. in 1941 and 1942, at a cost of $151,888.

FROM BECKWOURTH EAST FOR 9.3 MILES, the existing road brought to final alignment and grade in various stages over a period of nine years, and having been oiled by the penetration method, was surfaced with plant-mix 2½ inches thick and 22 feet wide. This work was done by Poulos and McEwen in 1941, at a cost of $46,663.

ON U. S. 395, BETWEEN CONSTANTIA AND HALLELUJAH, at the junction with the Feather River Highway, 12.1 miles, the existing penetration and road-mixed surfacing was reinforced with plant-mix from 2½ to 3 inches thick and 22 feet wide. This work was done by Fredericksen and Westbrook in 1941, at a cost of $59,412.

ON SIERRA WAY, BETWEEN CRESCENT MILLS AND GREENVILLE, 4.2 MILES, which was originally graded and oiled by the Public



Sketch map showing improvement on the Feather River Highway and tributaries by the State and Public Roads Administration

Roads Administration, an increment of road-mixed surface 2½ inches thick and 22 feet wide was placed in 1941 by Oranges Bros. and is now being sealed by day labor at a gross cost of $19,142.

On the Sierra Way the Public Roads Administration completed in 1941 two units. The work done consisted of grading and providing a stabilized base on which future surface will be required. One unit of 3.8 miles extended from Greenville north and the other of 6.9 miles was between Crescent Mills and the Feather River Highway near Paxton. The approximate cost of the Greenville unit was $64,935 and of the Crescent Mills to Paxton unit $299,702.

The aggregate length of several units of the Feather River Highway, or its tributaries, on which improvement was completed in 1941 or 1942 by the State or the Public Roads Administration is 70 miles and the aggregate cost was $987,184.

IMPROVEMENTS MUST CONTINUE

The work completed on these roads in the current biennial period clears the Feather River Highway of those deficiencies that are the most pronounced at the moment and constitutes a definite and appreciable contribution to better traffic service in and through the area. The type and pattern of the improvement must be continued and extended for an indefinite period if the highway system in the area is to be standardized and strengthened satisfactorily to serve even present requirements.

Conditions as to the inadequacy of this group of highways to meet requirements of a traffic that has outgrown expectations are but a replica of those applicable to any other group of highways in the State and serve to indicate that even the comprehensive program just completed here, while affording much relief, is "too little and too late" to keep up with traffic. This development of traffic occurred in spite of an almost complete lack of development on the most important tributary, the Sierra Way, as of that date. Also on the Feather River Highway itself the unimproved unit between Keddie and Quincy was a very severe deterrent to traffic. This unit, however, was in the process of improvement by the Public Roads Administration as a Forest Highway and was completed to its inital stage late in 1941.

"How come you didn't turn out?" demanded the sergeant. "Didn't you hear the bugle blow reveille?"

"Honest, sergeant, I'm afraid I'm going to be a flop as a soldier. I don't know one durn tune from another."

ALASKA WANTS IT

Territory of Alaska
Office of Highway Engineer
and Superintendent of
Public Works

Juneau, Alaska

Mr. J. W. Howe
California Highways and
Public Works
Sacramento, California

Dear Mr. Howe:

This office would greatly appreciate being put on the mailing list for your interesting publication. Thanking you in advance, I am

Yours very truly,

WM. A. HESSE,
Highway Engineer

RELEASES 200,000 TONS OF STEEL

At a recent Producers Council, Col. R. F. Fowler, Chief, Supply Division, Corps of Engineers, said: "On the new storage depot program alone, we expect to employ around 35,000 wood trusses, thereby releasing more than 200,000 tons of steel. That much steel, it is estimated, will build 7,500 medium tanks."

Smith had heard a conundrum that he thought was very good, so when he arrived home he concluded to try it on his wife.

Smith—Do you know why I am like a mule?

Wife—No, I don't, but I often intended to ask you.

State Sign Route 28 winds through heavy growths of Redwoods between Flynn and Navarro, a narrow road with sharp turns and grades

25 Curves to be Eliminated on Lateral Through Mendocino County Redwoods

By L. R. REDDEN, District Office Engineer

A LIFE span of virtually the entire American period in California—such is the background of a section of the McDonald-to-the-Sea Highway in Mendocino County, between Flynn Creek and Navarro, on State Sign Route 28, the improvement of which was recently placed under contract.

The improvement is located a few miles northwest of the lower end of Anderson Valley, which was settled in 1851. For 10 years thereafter, the only means of access from the valley to the San Francisco Bay area was over a pioneer road by ox team to the southeast to a connecting road at Cloverdale.

Then, in 1861, the road was extended westerly from the valley to the coast at the mouth of the Albion River. The extension was made primarily to provide access for the disposal of agricultural products from the Anderson Valley to the thriving sawmill communities lying along the coast, and incidentally to give a more ready access to the outside world.

The engineering standards were those required of most pioneer works: a passable road with a minimum of work. It was cheaper to go around a tree than to cut it down. The unit between Flynn Creek and Navarro has remained very much without change to this day, except for minor maintenance improvements, oiling and the replacement of bridges.

The route remained under the jurisdiction of Mendocino County until 1919 when it was taken into the State Highway System by the third State highway bond act. Since then, improvements have been made in the route from time to time so that of the few remaining unimproved sections, the Flynn Creek-Navarro unit is by far the most substandard.

The existing road has become entirely inadequate for present day traffic requirements due to the steeply pitching grade, the many sharp crested vertical curves and the almost angular alignment; and in many

places the roadbed is as narrow as 15 feet. The hazards of such a road have increased many fold due to the heavy increase in the movement of lumber by truck and trailer from the Fort Bragg area that began about 1935 with the decline and cessation of coastwise shipping.

An inspection of the following comparative data will indicate the degree of improvement that will be accomplished on the project:

	Present Road	Reconstructed Road
Length, miles	1.89 Mi.	1.90 Mi.
Total curvature	859 degrees	304 degrees
Min. radius	100 ft.	500 ft.
Curves under 500 ft. radius	25	0
Min. vert. sight distance	150 ft.	unlimited
Sight distances less than 275 ft.	4	none
Maximum grade	9.5	2.5%
Grade over 3	2725 ft.	none
Adverse grade	2575 ft.	625 ft.

The new road will follow closely the existing route; however, the irregular alignment is to be replaced by one of smooth flowing secondary road standards, and the many irregularities in grade will be entirely eliminated so that trucks may readily negotiate the road in high gear.

The planned roadbed is 26 feet wide in cuts and 28 feet wide in fills. An excellent selected material to be obtained from within cut slopes just east of the North Fork bridge is to be placed on the roadbed to depths ranging up to 14 feet, over the selected

(Continued on page [illegible])

A few giants must make room for a modern highway, and (above) the logs are being cut into commercial lengths

Defense Highway Program in California Reached $52,880,000

(Continued from page 11)

	ACCESS ROADS		STRATEGIC NETWORK	
	Projects Certified & Pending Certification	Contracts Awarded, Projects Advertised & Pending Advertisement	Projects Certified & Pending Certification	Contracts Awarded, Projects Advertised & Pending Advertisement
"C" Area				
Number of Projects	23	12	6	4
Miles	50.3	11.2	13.5	7.4
Bridges	3	3	4	4
Grade Separations	4	4	--	--
Amount	$7,489,700	$3,672,600	$1,562,900	$777,900
"D" Area				
Number of Projects	12	8	12	9
Miles	61.4	56.2	32.0	22.8
Bridges	5	2	7	7
Grade Separations	1	1	1	--
Amount	$2,161,000	$2,133,400	$2,169,600	$1,394,600
"E" Area				
Number of Projects	10	7	1	--
Miles	38.3	27.9	1.7	--
Bridges	2	1	--	--
Grade Separations	2	2	--	--
Amount	$2,003,900	$1,670,100	$195,000	--------

The above tabulations provide ready comparisons between the certified projects and construction set in motion to show the progress made by the Division of Highways in advancing the defense highway programs. The work involved in both access road projects and improvement to the strategic network include practically all phases of highway construction. While most of the road mileage being constructed is of the plant-mixed bituminous surface type, certain projects include portland cement concrete pavement and asphalt concrete pavement. The bridges included in the programs are of various lengths, some reinforced concrete and many are timber structures. The grade separations include separation of the grades of highways on heavily traveled routes as well as railroad separations. The grading involved has ranged from shoulder construction to heavy excavation.

From the data given, it may be seen that California is well into required defense highway construction and that every effort is being made by the Division of Highways to advance this phase of the National war effort.

Caution Urged To Reduce Crossing Accidents

DIRECTOR of Public Works, Frank W. Clark, appeals to motorists to exercise extreme caution at railroad and highway grade crossings.

Director Clark said his appeal was directed especially to defense industry workers in order to reduce the "alarming" death and disability toll which "is making serious inroads on man-power vitally needed for the war effort."

"Governor Olson has asked me" Mr. Clark said, "as head of the State agency which supervises our highways to sound a warning against carelessness which is responsible for accidents which hamper our war program.

"Increasing speed in production and in many other lines of endeavor directly connected with the war program is adding to the accident rate throughout the country.

"Man-power lost by accidental death last year could have built 7,000 heavy bombers, 20 battleships and 200 destroyers."

Clark stated that statistics of the Brotherhood of Locomotive Firemen and Enginemen were as follows:

"There was a 30 per cent increase in grade crossing deaths in 1940 over 1939 and last year there was almost a 10 per cent rise over 1940. One-third of grade crossing casualties are preventable. According to the interstate Commerce Commission, 35 per cent of such accidents result from automobiles smashing into the sides of trains.

"Last year, 1,931 persons lost their lives in railroad grade crossing accidents; the largest number since 1930. During the same year—1941—4,885 were injured at grade crossings. There were 4,320 of these accidents recorded in 1941, the greatest since 1937. In the first three months of 1942, 562 persons were killed and 1,580 were injured at grade crossings.

"Compared with the first three months of 1941, the number killed was over 7 per cent greater, and the number injured was almost 15 per cent greater than in 1942. Of course, increased traffic heightens the potentialities of accidents. The ton miles of traffic in 1941 were about 2 per cent higher than any year during World War I."

Grumm Loaned to W.P.B. As Priority Consultant

Fred J. Grumm, Engineer of Surveys and Plans of the Division of Highways was appointed Consultant to the Bureau of Governmental Requirements of the War Production Board by Maury Maverick, Chief of the Bureau, on June 1st.

Mr. Grumm was called to Washington to consult with Byron Scott, Assistant to Maury Maverick, in a series of conferences on priority procedure relating to road projects. Mr. Grumm reported to the bureau chief on the result of these conferences. The appointment of consultant without compensation, was made for the purpose of continuing an investigation and study of priority procedure.

In addition, the War Production Board Bureau Chief asked Grumm to represent him at vital annual board meetings in the Federal Region on the West coast. These meetings are held at Salt Lake, Seattle and San Francisco.

Mr. Grumm will attend each of these meetings and make reports to the War Production Board Bureau on projects brought up for discussion and the priority procedure pertaining to them.

Performance of Culverts and Survey of Culvert Practice

By G. A. TILTON, Jr., Assistant Construction Engineer

A series of articles presenting the results of a Joint Departmental Study of Performance of Culverts and Survey of Culvert Practice will be presented in future issues of the California Highways and Public Works Magazine to which the following is a brief introduction.

IN SO FAR as State-wide policies are concerned, highway drainage in California began with the inauguration of the State Highway System in 1912. At that time, rainfall and runoff data throughout California were meager and scattered and generally inadequate upon which to predicate engineering design.

It was not until 26 years later, in 1938, that the first of several general storms of extreme intensity occurred to test the validity of a quarter-century of highway drainage practice.

Although drainage structures in general functioned satisfactorily, there were sufficient inconsistencies in the performance of culverts and drainage facilities to warrant a comprehensive study and survey.

STUDY REQUIRED TWO YEARS

Such a study was ordered and conducted over a two-year period by a joint departmental committee of the Division of Highways, Department of Public Works, composed of the following personnel:

R. Robinson Rowe, Assistant Engineer, Bridge Department.
R. L. Thomas, Assistant Engineer, Surveys and Plans.
C. F. Woodin, Assistant Maintenance Engineer.
G. A. Tilton, Jr., Assistant Construction Engineer.

Field observations and studies covering the entire State indicate that culvert practice has long passed the stage where empirical determination of the size of a culvert opening is the all-important essential of design, emphasized to the point of disregard of other hydraulic and installation refinements.

Suggested and recommended changes in culvert practice resulting from the extensive survey are being presented with the object of engendering and encouraging progressive policies abreast the field of experimentation and experience.

In view of the general interest aroused by the committees' findings, recommendations and conclusions, a series of articles is to be presented in subsequent issues of the California Highways and Public Works Magazine, beginning with the September issue, covering the following subjects pertaining to culverts and drainage on the California State Highway System:

1. **Comparison of hydrology in California and midwestern and eastern United States.**
2. **Debris control at culvert entrances.**
3. **Culvert location and slopes.**
4. **Culvert entrances, headwalls, and drop inlets.**
5. **Culvert outlets and endwalls.**
6. **Siphon culverts and sag-pipe culverts.**
7. **Field installation of culverts.**
8. **Classification of culvert sites and selection of culvert types.**
9. **Rated waterways for culverts.**
10. **Maintenance of culverts and drainage ditches.**

OUR COUNTRY

"Let our subject be . . .
OUR COUNTRY,
OUR WHOLE COUNTRY,
. . . and nothing but
OUR COUNTRY.

And by the blessing of God, may that country itself become a vast and splendid monument, not of oppression and terror, but of wisdom and peace, and of liberty, upon which the world may gaze with admiration forever!" Daniel Webster.

25 Curves to be Eliminated Through Mendocino County

(Continued from page 17)

material a three inch course of gravel base is to be placed; and finally a one inch wearing course of road-mix is to be constructed on the gravel base to the full width of the roadbed.

Much of the country served by the project was once covered by dense redwood forest land which has largely been cut over. However, a very heavy stand of virgin timber still borders the project.

The heavily timbered terrain abounds with redwood trees ranging up to eight and 10 feet in diameter. Some idea of the cover may be gained when it is stated that the clearing expense for this 1.90 mile project is $15,395 or 26.8% of the entire bid price of $57,357. With so much clearing going on and with the cry of "timber!" echoing throughout the woods, the project takes on the atmosphere of logging operations rather than that of a road improvement project.

The bridge over the north fork of the Navarro River, which is crossed within the limits of the improvement, was built about 1931 and is in good condition. The foresight of the locators in placing the bridge has made it possible to develop the approaches to it under the present improvement without reduction in standard design.

Stability of the country traversed is generally good. Inspection of existing cut slopes, supplemented by soil studies, have led the engineers to design the slopes as steep as ½ to 1.

The project was originally programmed to be constructed in its entirety during the 1942 season, however, delays have resulted in obtaining the necessary release to construct from various governmental defense agencies so that the project will not be completed until 1943. The project is being financed in part with Federal funds.

John Burman and Sons is the Contractor; the work is under the jurisdiction of E. R. Green, District Engineer, with D. E. McCollum as Acting Resident Engineer.

Teacher—"Now, Bobby, tell me where the elephant is found."

Bobby—"The elephant is such a large animal it is scarcely ever lost."

Highway Bids and Awards for July, 1942

CONTRA COSTA COUNTY—Between the intersection with Route 14 in Hercules and ¼ mile west of Christie Underpass, about 3.6 miles to be repaired by placing crusher run base and surfacing with plant mixed surfacing. District IV, Route 106, Section Her.,A. E. A Forde, San Anselmo, $75,257. Contract awarded to Lee J. Immel, Berkeley, $73,497.

HUMBOLDT COUNTY—¼ mile north of Dyerville, about 0.2 mile in length, the road bed to be reconstructed, heavy stone riprap and wire and rock mattress to be constructed. District I, Route 1, Section D. Harold Smith, St. Helena, $69,058; Ralph A. Bell, Eureka, $70,471; Mercer, Fraser Co., Eureka, $73,191. Contract awarded to Schemmann & Johnson, Redding, $66,819.

HUMBOLDT COUNTY—Between Arcata and Eureka, about 11.5 miles in length, portions to be graded and surfaced with plant mixed surfacing on gravel base, and portions graded and surfaced with gravel base and bituminous seal applied. District I. Ralph A. Bell, Eureka, $381,912. Contract awarded to John Carlin Construction Co., Arcata, $327,827.

KERN COUNTY—Across Grapevine Creek, about 5 miles north of Lebec, an existing bridge to be widened. District VI, Route 4, Section A. R. M. Price, Huntington Park, $51,930. E. E. Smith, El Cerrito, $68,349; R. L. Oakley, Pasadena, $73,400. Contract awarded to Trewhitt Shields and Fisher, Fresno, $51,256.

KERN COUNTY—Between Route 138 and Gardner Field, about 5.6 miles to be graded and bituminous surface treatment applied. District VI, Griffith Co., Los Angeles, $181,340. Contract awarded to Louis Biasotti & Son, Stockton, $157,920.

LASSEN COUNTY—Between Route 29 and Reservation Boundary, near Honey Lake, about 1.3 miles, a base to be constructed of imported borrow and surfaced with road mixed surfacing. District II. Harms Bros., Sacramento, $43,412; A. Teichert & Son, Inc., Sacramento, $43,845; Clifford A. Dunn, Klamath Falls, $46,830. Contract awarded to Poulos & McEwen, Sacramento, $39,848.

LOS ANGELES COUNTY—Between Centinela Ave. and Slauson Ave., about 0.5 mile to be surfaced with Portland cement concrete pavement. District VII, Route 158, Section B. Contract awarded to Griffith Co., Los Angeles, $42,590.

MERCED COUNTY—Between Route 4 near Buhach and Merced Flying School, about 2 miles to be graded, bituminous surface treatment to be applied to central portion of the roadbed and penetration treatment applied to shoulders. District X. Elmer J. Warner, Stockton, $51,983. Contract awarded to E. A. Forde, San Anselmo, $50,138.

MONTEREY COUNTY—Between Reservation Boundary and 0.7 mile north of Monterey Avenue in Marina, about 1.5 miles to be graded and paved with Class "B" Portland cement concrete. District V, Route 56, Section I. Contract awarded to Walter J. Wilkinson & H. B. Scott, Watsonville, $217,592.

SACRAMENTO COUNTY—Portions between Sacramento city limits and Auburn Blvd., about five miles, shoulders to be constructed and plant mixed surfacing to be placed over existing pavement. District III, Route 98, Section A. McGillivray Construction Co., Sacramento, $54,912. Contract awarded to A. Teichert & Son, Inc., Sacramento, $48,871.

SAN BERNARDINO COUNTY—Across Day Canyon Flood Channel about 13 miles west of Colton, a reinforced concrete bridge to be constructed. District VIII, Route 26, Section D. Byerts & Dunn, Los Angeles, $29,271; R. L. Oakley, Pasadena, $32,150. Contract awarded to Carl Hallin, Los Angeles, $28,508.50.

SAN DIEGO COUNTY—In City of San Diego, on Barnett Ave. and Lytton Street, between Rosecrans Street and Pacific Highway, about one mile to be graded and paved with Portland cement concrete and Asphalt concrete. District XI, Route 12, Sections S.D., Barnett Avenue. V. R. Dennis Const. Co., San Diego, $131,240; Daley Corp., San Diego, $134,986; Griffith Co., Los Angeles, $136,015. Contract awarded to R. E. Hazard & Sons, San Diego, $126,759.90

SAN MATEO COUNTY—Between 2 miles south of Tunitas and 1 mile south of Lobitos, about 2.6 miles in length to be graded and penetration treatment applied. District IV, Route 56, Sections B,C. Chas. L. Harney, San Francisco, $297,065. Contract awarded to Harms Bros., Sacramento, $255,768.50.

Highway Division Designs New Traffic Signal Blackout Unit

(Continued from page 5)

The first observation from the air was made from a plane by Lt. Colonel R. T. Lester, U. S. Army Air Corp, attached to Moffett Field. Following is a copy of his report:

"The last check on the blackout bracket check-light at the intersection of Highway 101 and the Moffett Field entrance, proved very successful, the light being visible at three miles and 800 feet.

"I believe you have found the answer to the traffic situation during blackouts and I do not believe a more successful system could be devised."

A second observation was made from a Navy blimp, and the following is quoted from the Pilot's report to Commander Mackey of the U. S. Naval Air Station at Moffet Field:

"1. At 2,020 on the evening of 24 April 1942 conducted preliminary observation tests of the Bayshore highway traffic light system just outside the station (by Tiny's Cafe). Weather was clear, visibility 15 miles.

"2. It was originally intended to commence observation at such a low altitude and distance that the lights were definitely visible and to make succeeding runs at 500 feet increments of altitude up to 2,000 feet.

"3. However, this was not necessary because of the efficiency of the blackout traffic lights. Two runs were made. The first run was started at 500 feet exactly two miles away from the west lights. Complete darkness prevailed until at ½ mile away (500 feet altitude) when a very dull red reflection became visible on the pavement. This red reflection on the pavement, it is believed, would be invisible if pavement were painted black at intersection. At no time during this run were the actual traffic lights seen, although altitude was decreased to 300 feet ½ mile from the lights to directly overhead.

"Second run was made at 500 feet from the south primarily to test efficiency of the amber flashing signal. Complete blackout conditions prevailed on this run until ¾ mile from the amber signal. At this distance altitude was decreased to 300 feet whence a dull amber reflection on the pavement became visible (at no time was light seen). Altitude was increased from 300 to 500 feet and the dull amber reflection on the pavement disappeared and total darkness prevailed.

"No other runs were made at this time. All observations were made through powerful 7/50 power binoculars and with the naked eye by co-pilot and myself."

As a final check, arrangements were made for an officer of the Fourth Air Force to observe the installation. All sign lights, street lights, and other conflicting lights near the intersection were turned off before observations were made.

Lt. Colonel Kinzie reported that several flights at varying elevations from several directions were made over the intersection and at no time were the traffic lights visible from the air.

Candidate: "How did you like my speech on the agricultural problem?"

Farmer: "It wasn't bad, but a good day's rain would do a heap more good."

State of California
CULBERT L. OLSON, Governor

Department of Public Works
Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

FRANK W. CLARK, Director of Public Works

ROBERT H. ROOT, Assistant Director

MORGAN KEATON, Deputy Director

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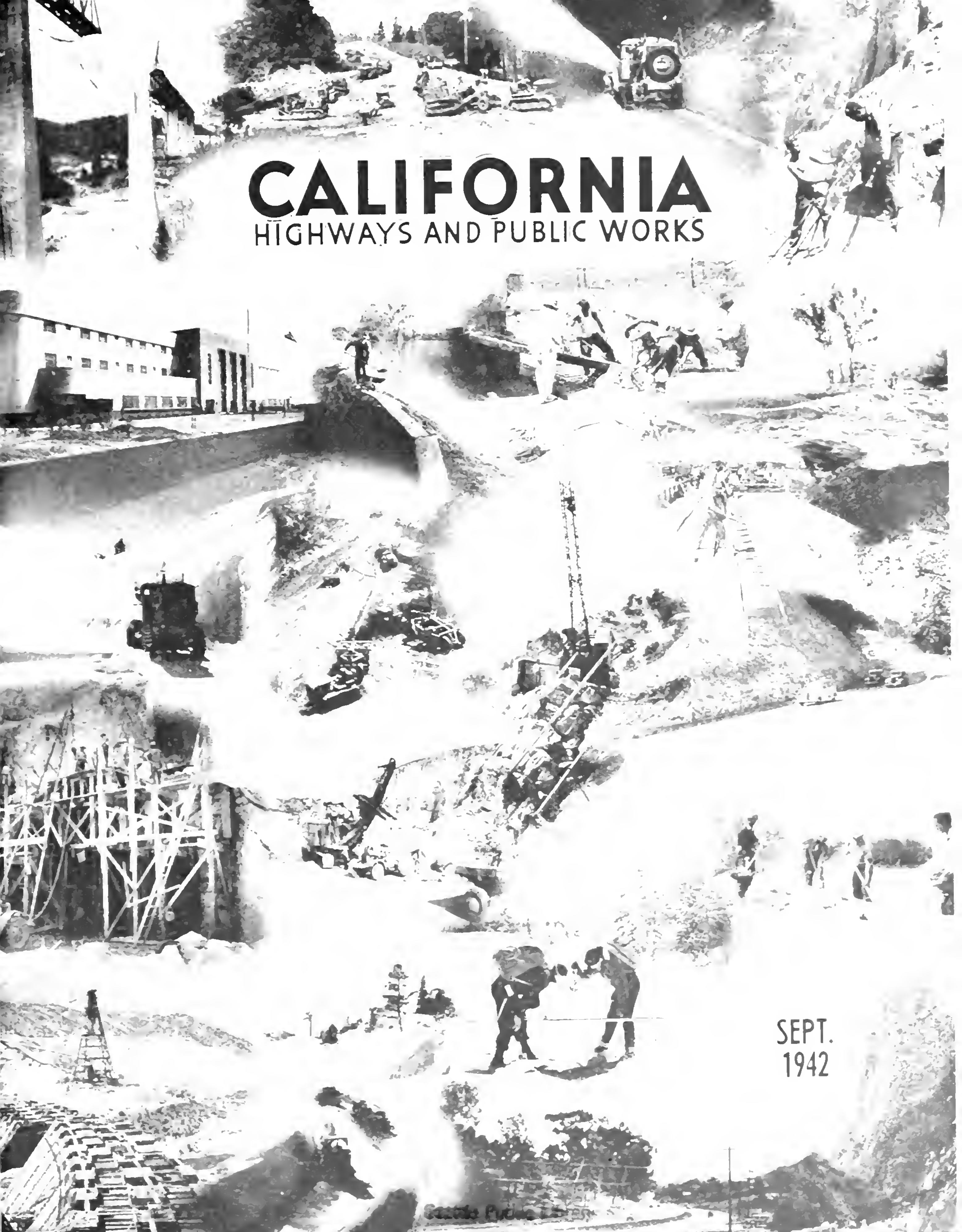

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// CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California

FRANK W. CLARK, Director C. H. PURCELL, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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Vol. 20 SEPTEMBER, 1942 No. 9

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Procedure and Factors Governing Issuance of Overload Permits for Trucks Using State Highways

By STEWART MITCHELL, Assistant Bridge Engineer

IT IS closing time, and as the office force is leaving the phone rings. The engineer in charge answers and a voice says the Blank Trucking Company wants a permit to take an overweight load from Weaverville to Long Beach.

The information is offered that the movement is necessary because the armed forces or the Maritime Commission require it, that the gross weight of the vehicle is about so many tons and that the vehicle is loaded and ready to start.

The fact is emphasized that the trip must be made in connection with the war effort, with the evident conviction this is good and sufficient reason for granting the permit at once.

MORE DETAILS REQUIRED

The engineer begins to extract from the phone caller some needed information as to the type of vehicle, its axle weights, the distances between them and the number of tires on the heavy axles. Too often the information asked for can not be given in satisfactory detail and sometimes in only a very vague way.

The reason why this information must be obtained is patiently explained: how the safe load on a bridge varies with all possible combinations of axle weight and spacing, and how the highway surface can be damaged by too heavy a wheel load.

As the engineer talks, he is considering the available roads by which the trip can be made, which of them have weak bridges and which may have restricted clearances. He must decide upon the route before the final answer can be given.

VERY LITTLE DELAY

The problem is complicated, but all information and procedure has been systematized and if those who are asking about the possibility of getting an overload permit will cooperate to the extent of being able to give the engineer a few simple facts, the permit, if justifiable, can be obtained with very little delay.

First of all it should be understood that the United States Government is not requiring, and not even asking any State to permit heavier loads to operate over its highways than it considers are safe for the bridges and other road structures.

This will be evident from the fact the Office of Defense Transportation modified its Order No. 3 which originally conflicted with State Vehicle Laws, and did it in such language that made it plain there is no intention to supersede such laws.

However, the Federal Government, through the Council of State Governors, has requested that all States whose laws restrict the size and weight of vehicles to less than certain minimum amounts recommended by Commissioner Thos. H. MacDonald of the Public Roads Administration, revise these laws in accordance with his recommendations.

CALIFORNIA MORE LIBERAL

Many States have done this, but no action is necessary on the part of California since the provisions of its vehicle code are more liberal than the recommended restrictions and, in fact, are generally more liberal than those of the other States.

Formerly, the California Vehicle Code limited the gross weight of a vehicle by specifying a maximum axle load and a maximum gross weight for each of the common vehicle types. At the last session of the Legislature the law was changed so that gross weight is now restricted by axle load and by a formula which is applied to axle groups and to all vehicles or combinations of vehicles.

The formula permits the gross weight of the vehicle to be increased in proportion to the length of the wheel base conforming in as practical a manner as possible to the engineering laws which determine the safe load capacity of bridge structures. It is as practical a procedure as has been devised to allow a maximum gross load and still protect the public's investment in highways and bridges.

All possible conditions of axle arrangement, bridge type and condition, and vehicle operation, can not be covered in any practical manner by laws that are to be of general application. To try and do this would make it impractical to enforce the law. This fact is recognized and taken care of by the provisions that give the Department of Public Works power to cut down the legal load if the bridges or road surfaces are not up to standard, and power to increase the legal load if conditions and circumstances make it advisable to do so.

As a matter of practical procedure, the operation of heavier loads than the law specifies is governed by special permits which state the conditions under which a particular load can be moved over a designated section of highway and which fix the responsibility in case of any damage to structures.

REASONS FOR EXCEPTIONS

There are several good engineering reasons why it is sometimes possible to move heavier vehicles on the highway than are permitted by the general provisions of the law. The more important are:

1. Certain bridges are of a type and span length that conform to the axle concentrations of a particular vehicle and may, in consequence, support a somewhat heavier gross load than the legal maximum without material encroachment on the normal factor of safety.

(Continued on page 19)

New Cut-off Between Rio Vista and Lodi Opened. Saves 10 Miles

By C. J. TEMBY, District Office Engineer

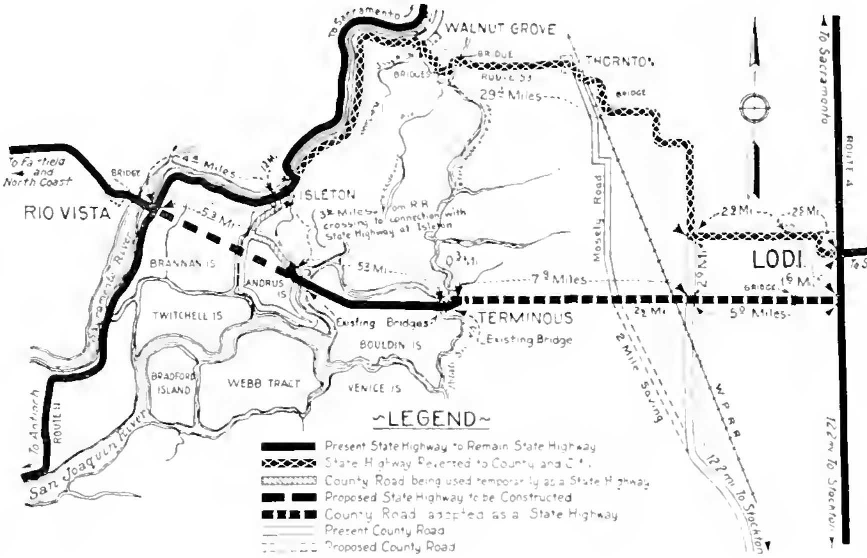
WITH the opening to traffic on July 25, 1942, of a portion of the Rio Vista-Lodi cut-off, it is possible for traffic, between Rio Vista and Route 4, in the vicinity of Lodi and Stockton, to save approximately 10.0 miles over the distance required to travel via the old route.

In addition to the great saving in distance, a much safer riding road is provided. A description of the old hazardous road via the levees, Walnut Grove, Thornton, and over the various bridges, and details of the proposed new alignment and grade were described in previous issues of this magazine. (See April, 1940, and April, 1941.)

There remains about five and one-half miles of the proposed cut-off between the Mokelumne River and the easterly end of the bridge across the Sacramento River, near Rio Vista, to be constructed. The surveys have been made for this portion of the cut-off, but due to the war program, it is doubtful whether this unit will be constructed for some time.

For traffic to use the completed portion of the new cut-off, it was necessary to make connections with the existing county road along the levee of Georgianna Slough, then on to Isleton connecting with the old State Highway. From Terminous to the connection with Route 4, near Lodi, the county road was adopted as a State Highway, but because of shortage of funds and the war situation, it has not been improved to the condition required or ultimately expected.

It was necessary because of the adjacent peat land, which is highly inflammable, to post signs informing the traveling public of the danger of fire and to caution them against throwing away matches and cigarette stubs. To date, since taking over this road, several fires have occurred along the roadbed in the vicinity of Terminous. As explained in the previous articles, the construction of the road is over



agricultural lands of the rich delta islands of this area, and this particular road is over peat varying in depth from 20 to 45 feet.

Devices for measuring future settlements of the highway have been installed at the direction of the Testing and Research Laboratory in order to provide information of value for further use in projects such as this.

Excepting for the shortage of materials, equipment, and men, due to the war activities, no unusual difficulties were experienced in the construction of this latter unit of the road. The fill was made of sandy material dredged from the Mokelumne River and the surfacing was treated with liquid asphalt (RC-2) by the road-mix method for a thickness of four inches, compacted.

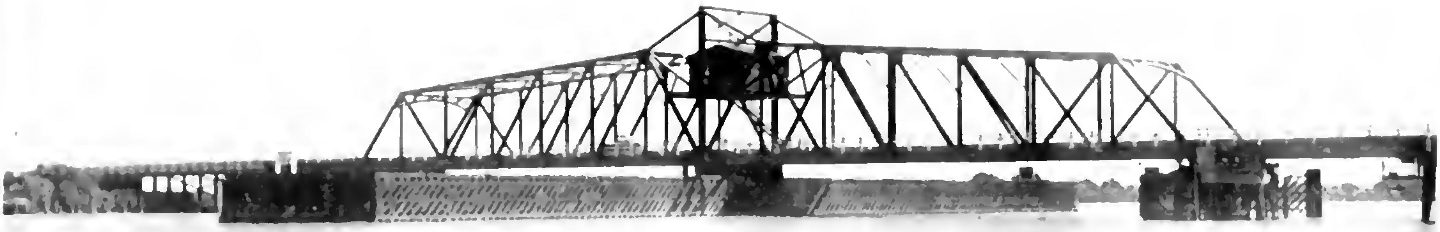
The Testing and Research Laboratory, as well as Central Office Construction Department were in constant touch with this job during its construction period. In general, the work was completed as designed, excepting for a few locations where settlements appeared to be more rapid than anticipated in the preliminary design, at which locations additional funds were provided and more fill material placed.

George R. Hubbard, Associate Highway Engineer, was Resident Engineer for the District and Clyde Wood was the contractor on the road project. C. C. Winters, Associate Bridge Engineer, was Resident Engineer for the Bridge Department on the Mokelumne River Bridge.

With the completion of this cut-off the old portion of the State highway from Lodi to the east end of the Isleton Bridge across the Sacramento River was reverted to Sacramento and San Joaquin counties, respectively.

For the through traffic using this portion of the highway it was fortunate indeed that the State had completed and opened this section of road at the time it did, for on July 26th, the day following the opening of this road, a heavily loaded truck of lumber struck the Miller's Ferry Bridge on the old highway route and caused the easterly end of the floor system to collapse, thereby placing this road out of service.

(Continued on page 18)



View of the new steel span drawbridge across the Mokelumne River on the recently opened Lodi-Rio Vista cut-off highway

New Lodi-Rio Vista cut-off highway looking East from the timber trestle approach to Mokelumne River Bridge

Four-Lane Divided Highway Reduces Traffic Hazard East of Redlands

By A. EVERETT SMITH, Assistant District Construction Engineer

ONE of the most dangerous portions of substandard alignment on the Los Angeles-Imperial Valley Highway remained until recently in the Crystal Springs area, adjacent to the East City Limit of Redlands. This is a part of the combined U. S. Highways 99 and 70. This route carries heavy trucking traffic and normally is subjected to a large volume of recreational and tourist traffic in addition to the more localized type of travel.

A particularly hazardous condition was present where grades were involved. This was due to the fact that heavily laden trucks traveling up grade were forced to shift to lower gears and proceed at greatly reduced speeds. Automobiles traveling in the same direction necessarily were forced to pass using the opposing traffic lane, or remain behind the slow moving trucks. Too often, they were tempted to pass without adequate sight distance, resulting in collisions, or near collisions.

As a step toward improving this section, a project has been completed by Dimmitt and Taylor, Contractors, for constructing a graded two-lane roadbed, in general parallel to the existing road. A dividing strip was left between the newly constructed east bound and the existing west bound dual lanes to produce a four-lane divided highway.

The existing two-lane pavement that was of substandard alignment when carrying opposing traffic is now subject to east bound traffic only. Thus by eliminating the factor for passing sight distance, necessary where there is opposing traffic, the alignment is satisfactory for present traffic conditions.

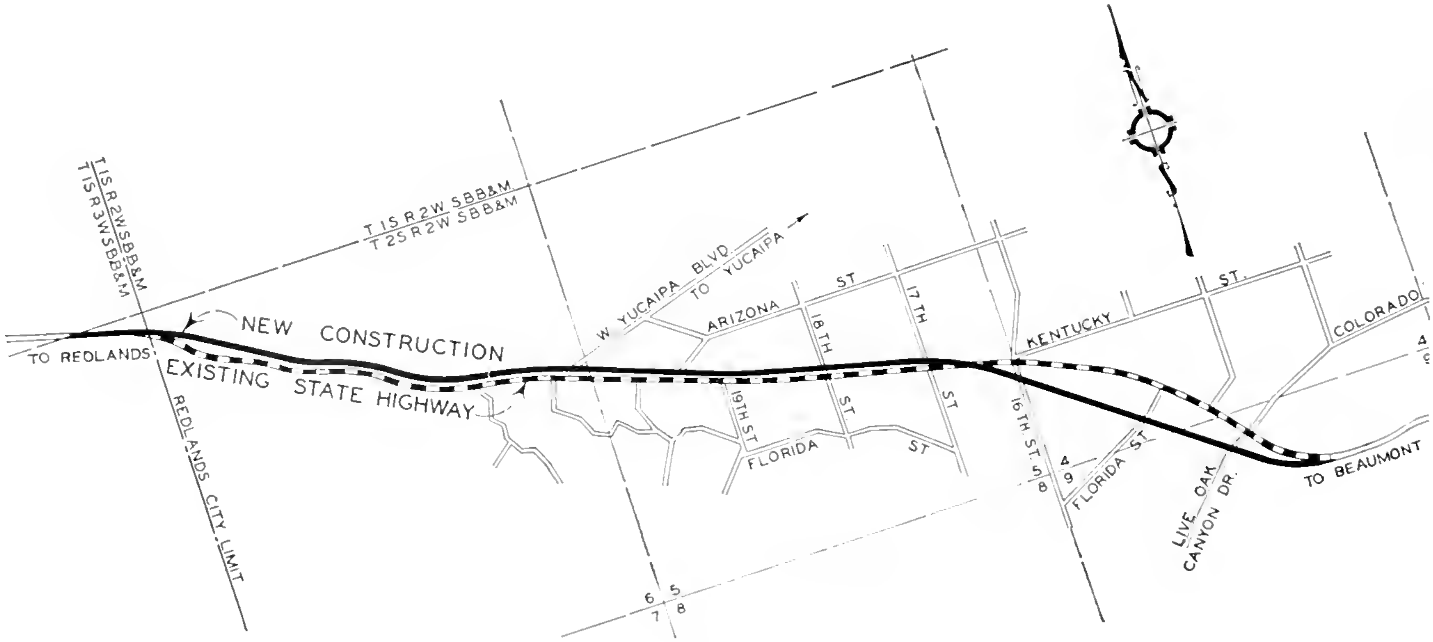
About one mile of the easterly end of the project is entirely on new location. In this portion a transition section is introduced, decreasing the roadbed width to a two-lane section at a point of adequate sight distance before merging into the existing two-lane pavement ahead.

A later contract was awarded to the contracting firm of Oswald Bros., consisting principally of constructing a cement treated base and placing a riding surface of asphalt concrete pavement over the project previously graded.

Cement treated base material was mixed in a mixing plant set up within the limits of the job. Mineral aggregate was obtained from sections adjacent to the roadbed near the plant location. After the aggregate was crushed to meet specification requirements, it was batched and mixed with water and approximately 7½ per cent of portland cement by weight of aggregate. A pugmill type mixer was used.

The mixture was hauled to the street in dump trucks and spread through a self-propelled mechanical spreading machine with a strike-off tamping screed. The spreader pushed the truck ahead of it while discharging. This operation was followed by a heavy three-axle roller for compaction. For surface consolidation a

(Continued on page 18)



Four-lane divided highway East of Redlands. New construction for dual West bound traffic lanes on left. Existing highway on right

View showing transition section where divided highway merges into two-lane existing highway ahead at end of project

Spreading cement-treated base material with self-propelled mechanical spreading machine which pushes truck discharging material ahead of it

Comparative Hydrology Pertinent to California Culvert Practice

By R. ROBINSON ROWE, Assistant Engineer, Bridge Department
and ROBERT L. THOMAS, Assistant Engineer, Surveys and Plans

As announced last month, this is the first of a series of technical abstracts to be published in future issues of California Highways and Public Works. These abstracts are taken from a joint departmental report of culvert practice of the California Division of Highways by a committee composed of Geo. A. Tilton, Jr., Assistant Construction Engineer; Clarence Woodin, Assistant Maintenance Engineer, and the writers. Appropriately, the series opens with comparative hydrology, demonstrating the necessity for divergence of California practice from that developed for other areas.

IN its humble way, a culvert is a grade separation structure, passing hydraulic traffic under highway traffic. Adequate way must be provided for each, but our procedure for estimating volumes of the two traffics has been distinctly contradictory.

On the one hand, vehicular traffic is recorded at regular intervals on all routes, to determine volume of traffic and trend. Probable traffic for some definite time in the future is estimated from present volume and trend; then, funds permitting, way is designed for such traffic. Frequency of peak traffic may be daily or weekly or seasonal; congestion during peaks is an inconvenient rather than a damaging consequence, even if traffic is double the estimate.

On the other hand, hydraulic traffic is not regularly recorded in advance. Some agencies collect hydrologic data on streams in which water is an asset but data is not assembled for water as a liability, except in a few flood-control districts. Few data are collected for either purpose on culvert-size streams.

Barring catastrophic changes in climate, construction of dams, or alteration of culture, hydraulic traffic has no trend, but it does have frequency. This frequency (or infrequency) is important in design and can not be determined by the most thorough survey of the site, at any one time or in any short period.

Congestion of waterway is more than inconvenient—it is destructive. Analogous to the queueing of impeded traffic is the ponding of obstructed water—which may damage embankments or private property. Analogous to a condition of traffic congestion that would enforce the detouring of vehicles through adjacent areas is the diversion of a flooded stream out of its banks and over the roadway—erosively. Analogous to the impulsive charging and weaving of impatient vehicles on a crowded roadway is the destructive surging and turbulence of impetuous water within and without the culvert.

The analogy fails when we predict the two traffics. From volume and trend, highway traffic can be predicted reliably for any given year in the immediate future. Hydraulic traffic can not be foreseen in the same way, as next year's flood may be a trickle or a deluge.

If basic data is available, we can estimate statistically the extreme flood which will occur, on the average, once in (say) 100 years, calling it a "100-year flood." Such a flood is just as likely to occur in 1943 as in 2042, but the odds are 99 to 1 against such a flood being equalled or exceeded in any particular year.

The term "100-year flood" may be applied to any statistical phase of a flood—its stage, duration, mean daily discharge, momentary peak discharge, etc. For culverts, the critical phase is the momentary peak. Hence in this paper we will define the "100-year flood" as the momentary peak discharge which will occur, on the average, once in 100 years. By the phrase "on the average," it is implied that all peaks could be ob-

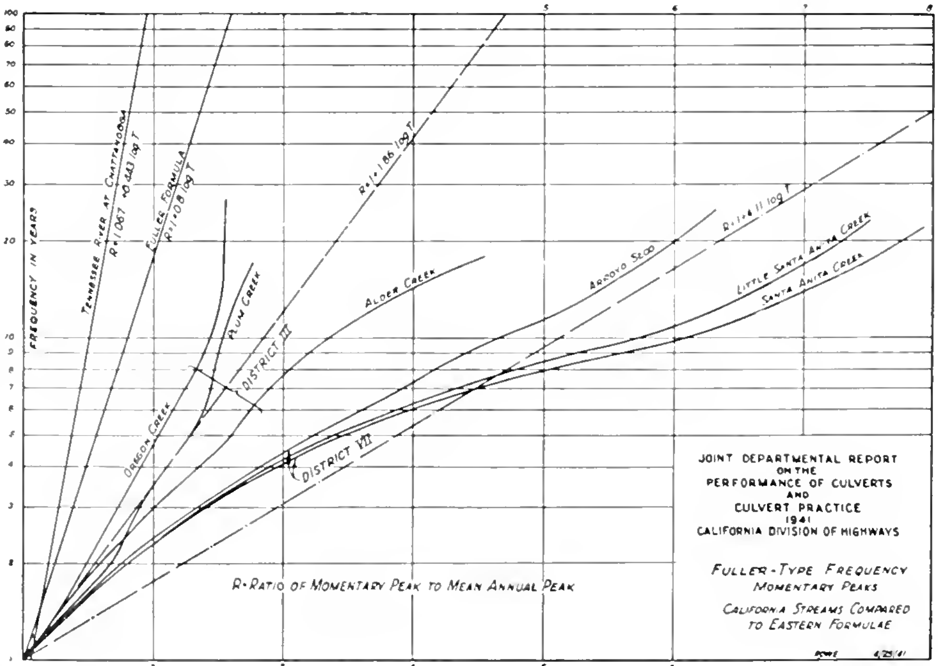


Figure 1. Comparison of eastern flood frequency with that of two regions in California

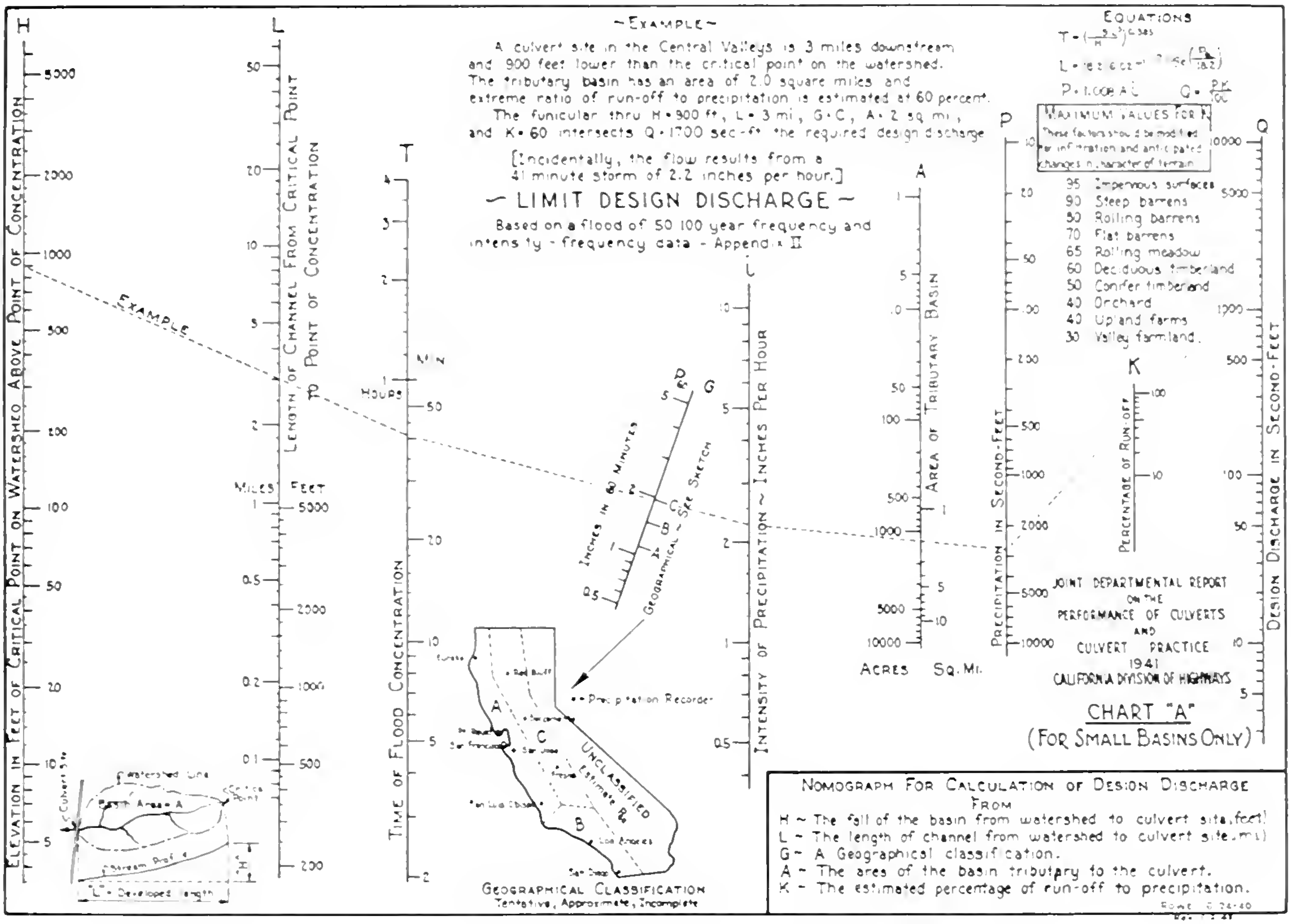


Figure 2. Chart A for calculation of "design discharge" by a new formula in nomographic form

served for a series of centuries and an average struck of century peaks. This is Fuller's concept (1)* applied to small streams.

The Fuller concept is adaptable to short records of culvert-size streams, as it appears to yield a simple exponential relationship between frequency and flood magnitude. The more advanced statistical procedures of Foster, Hazen, Goodrich, Harris and Slade (2) may be nearer the laws of nature and chance, but these are not applicable to short records.

FLOOD FREQUENCY PLOTTED

This may be illustrated by reference to **Fig. 1**. On this chart, frequency in years is plotted to a logarithmic scale against momentary peak to a natural scale. For comparison of a number of streams, the unit of discharge for each stream is its mean annual peak so that the graph is nondimensional.

Fuller reasoned, from study of many eastern streams, that flood records plotted in this way should yield flat curves which would straighten as the record lengthened. Hence the slope of the lower part of the curve would permit an estimate of the ultimate straight-line variation, from which long-period floods could be predicted. Departure of the upper part of the curve from such a line only proved that the period of record was not a random sample.

Fuller established that curves of several streams in one climatic region had nearly the same slope, which led to the Fuller Formula: **R = 1 + 0.8 log T** where R is the ratio of the T-year flood to the 1-year flood.

Saville (2a) found that this formula could not be applied in another region (Tennessee Valley). He concluded that the data conformed closely to a straight-line plot (shown on **Fig. 1**) but that a flat curve would be better.

CALIFORNIA FREQUENCY

Also plotted on **Fig. 1** are flood data from 6 small California streams from two distinct climatic regions. The curves demonstrate an approximate law for each region, differing severely from each other and from eastern laws.

These streams were selected as the smallest for which there is a fair record (17-28 years) and negligible regulation. Basic data and deductions are shown in **Table I** (see next page), including the common statistical coefficients (2a).

The diversity of frequency may be illustrated by applying **Fig. 1** to four hypothetical streams for which the mean annual peak is 100 second feet. On the first, in Tennessee, a flood of 200 second feet (R=2) would occur, on the average, once in 128 years.

* Numbers in parenthesis refer to bibliography at end of article.

Table I. Frequency and statistical factors of 6 small California streams compared to eastern types

STREAM	Basin Area Sq. Mi.	Length of Record Years	Gage Elevation Feet	Mean Discharge Sec. Ft.	Annual Momentary Peak: Minimum Sec. Ft.	Mean Sec. Ft.	Maximum Sec. Ft.	Statistical Coefficients: Variation CV	Skew CS	Adjusted Skew CS	Pearson Skewness	Fuller's Constant R-1 / Log T	Ratio of 100-Year Flood: To Annual Flood	To 10-Year Flood
Eastern U. S.														
Fuller Ideal	--	20	--	--	661	1,000	2,041	0.347	1.53	2.00	0.69	0.8	2.60	1.44
Tennessee River	21,400	57	620	38,300	85,900	208,600	361,000	0.280	0.32	0.38	0.25	0.5	1.95	1.29
District III														
Plum Creek	6.8	17	4,100	8.1	33	230	635	0.823	0.64	0.97	0.55	1.70	4.40	1.63
Alder Creek	22.8	18	4,000	30.0	92	387	1,760	1.039	2.30	3.38	0.50	2.43	5.86	1.71
Oregon Creek	35.1	28	1,500	72.5	295	1,596	4,080	0.656	0.90	1.18	0.60	1.45	3.90	1.59
District VII														
Little Santa Anita	1.9	22	2,200	1.0	3	107	800	1.736	2.83	3.93	1.03	4.31	9.62	1.81
Santa Anita Creek	10.5	22	1,400	5.6	34	672	5,330	1.847	2.91	4.04	0.71	4.46	9.92	1.82
Arroyo Seco	16.4	25	1,400	9.6	81	1,366	8,620	1.431	2.51	3.38	0.44	3.57	8.14	1.78

In Fuller's region, the frequency would be 18 years; in District III* of California, 3.5 years; in District VII,* once in 1.75 years.

If, for each stream, we compute the 100-year flood, we find: in Tennessee, 195 second feet; in Fuller's region, 260 second feet; in District III, 472 second feet; in District VII, 922 second feet.

These deductions from **Fig. 1** should be considered illustrative, not quantitative. There may be areas in California, such as the north coast, where the Fuller Formula would apply with slight adjustment. There are other areas, such as the southern deserts, where the law must be more extreme than in District VII. As data are collected, hydrologic laws will be defined more precisely—both as to boundaries of regions and statistical constants. This has been started in District VII on a noteworthy scale (3).

MISCONCEPTIONS OF FREQUENCY

Before leaving the subject of frequency, there are a few points that require further explanation. One, in particular, is the probable frequency of recent floods observed at highway bridges and culverts.

Suppose, for illustration, we take a random group of 10,000 drainage basins in California, selected by some arbitrary rule—say those intercepted by the 10,000 largest cross-drainage highway culverts. Suppose also that we had observed the maximum annual flood at each of these culverts for 10 years. Suppose further that weather was random and noncyclic. Then it is probable that, of the 100,000 annual floods, 10,000 were 10-year floods or greater, 1,000 were 100-year floods or greater, 100 were 1,000-year floods or greater, etc.

On the average, 10 floods of 1,000-year frequency were experienced each year, somewhere in the group. But, of course, there were more than 10 in "wet years," less than 10 in "dry years." This is significant. Finding report or water marks of a recent flood of such infrequency, an engineer will be inclined toward over-design.

On the contrary, there is a possibility that some basin just missed the big storms, so that the maximum flood experienced in 30 years is only a 5-year flood. Here the reports and water marks will lead to under-design.

WEATHER CYCLE CONCLUSIONS

Weather cycles, whatever the cause, may also lead to erroneous conclusions as to frequency. Historical summaries (2b) recall that floods were general throughout California in the 10 climatic years 1862, 1868, 1879, 1881, 1890, 1907, 1909, 1915, 1916 and 1938. On the average, California experiences one general outstanding flood every 8 years, but intervals range from one year to 22 years.

Over-design probably followed the 4 floods in one decade, 1907-1916, just as under-design was the rule toward ends of the droughts of 1891-1906 and 1917-1937. To avoid generosity in current designs, following a new series of flood years, frequency studies must determine a normal expectancy.

NO FLOOD UPPER LIMIT

Fuller-type frequency has been criticized because there is no upper limit to floods. The curve for Santa Anita Creek can be extended to determine how often we can expect 50,000 second-feet to pass that way—once in 26,000,000,000,000,000 years. Both discharge and time are so remote as to be meaningless. If such a flood is even remotely possible, it doesn't matter if the curve lacks a limit.

On April 5, 1926, there was recorded (3) a fall of 1.03 inches of rain in 60 seconds at Opid's Camp, not far from the basin of Santa Anita Creek. Had it extended over the 10.5 sq. mi. of the basin, the fall would have been at the rate of 419,000 second feet.

Using conservative factors in application of unit hydrographs, this would have produced a peak of 50,000 second feet at the Santa Anita gage 13 minutes later.

Practically, then, we can not conceive of a limit flood. What may happen once in 26 quadrillion years

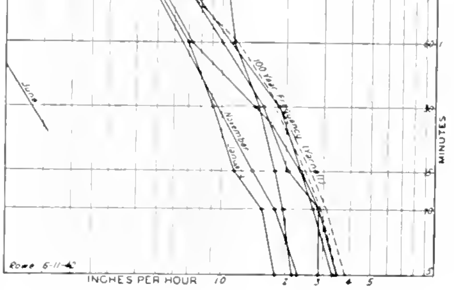


Fig. 3g. Precipitation intensity at Eureka

* State Highway Districts.

Figure 3a

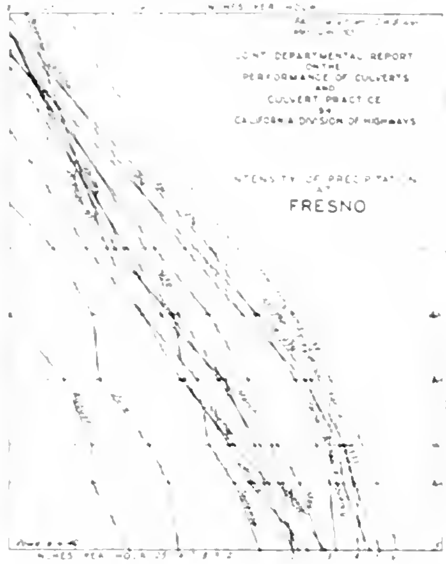


Figure 3b

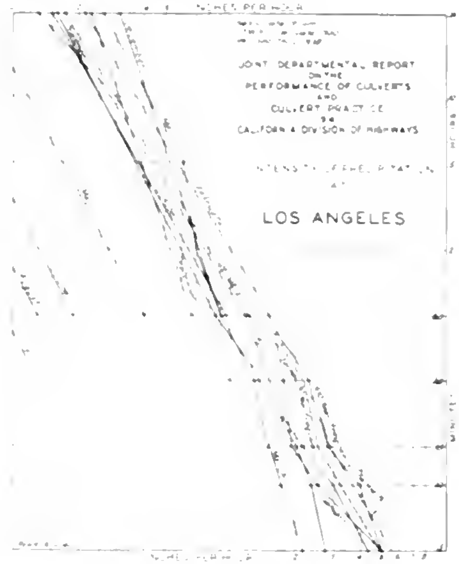


Figure 3c

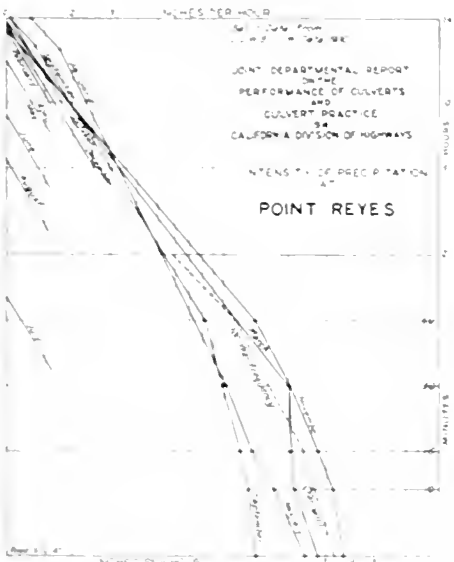


Figure 3d

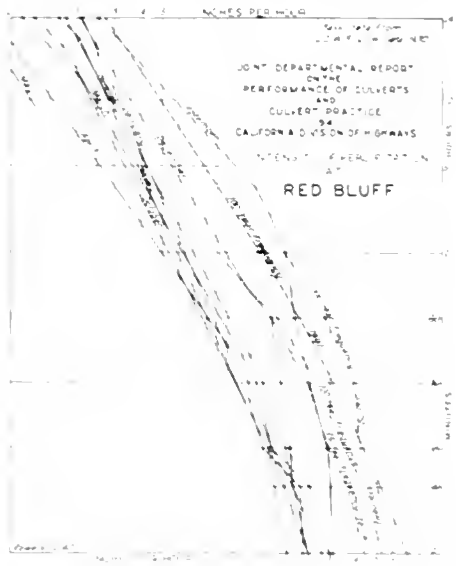


Figure 3e

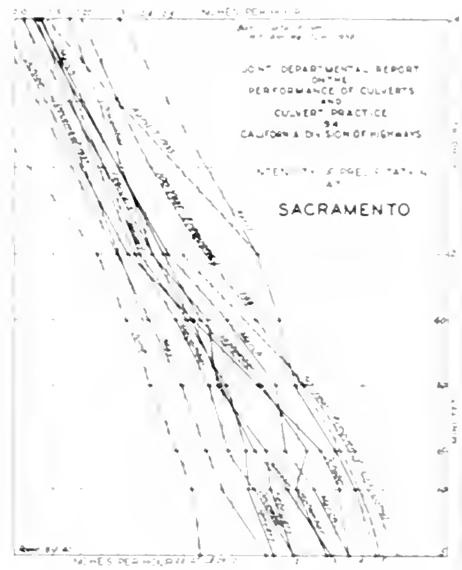


Figure 3f

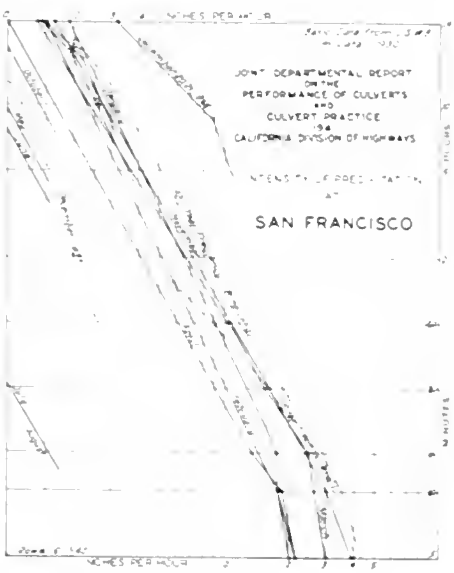


Figure 3h

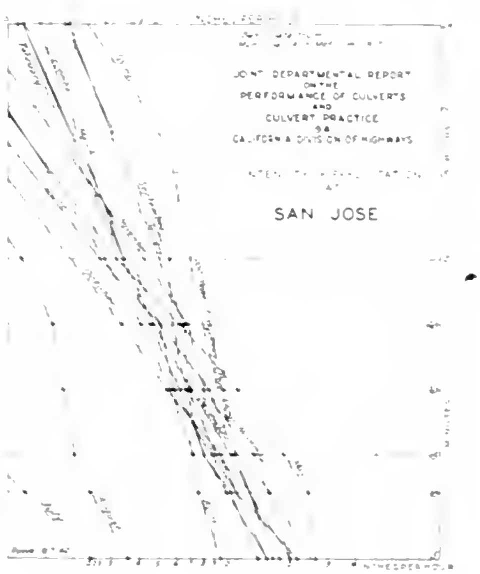


Figure 3i

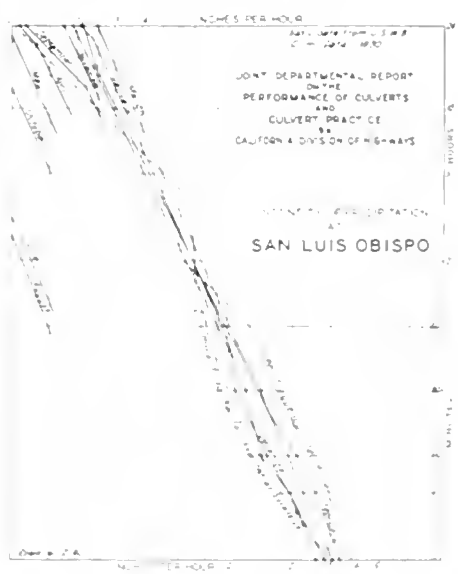


Figure 3j

Figures 3a to 3j. Maximum intensity of rainfall at gages shown may happen in 1943. The obvious impropriety of designing for such indefinite extremes has led to the conception of the "design flood."

"DESIGN FLOOD" ESTIMATES

If, for a certain site, we can estimate reliably the magnitudes of floods which should occur, on the average, with certain frequencies, we can select the flood of some one frequency as the "design flood" from principles of economy. We can estimate the damage likely to be caused by greater floods and compute the annual cost of this contingency. This should just equal the allowable annual cost of additional capital investment to provide waterway for the greater flood.

For large bridges, a separate study can be made for each site, to obtain maximum benefit in economy. For culverts and small bridges, some rule-of-thumb is required. The Committee recommended two general rules:

(1) that a culvert just pass a 10-year flood without static head on crown of culvert at entrance; and (2) that design of culvert and appurtenances be balanced to avoid serious damage from head and velocity obtaining in a 100-year flood.

Of course there will be justifiable exceptions to any such rule, some of which will be discussed in a later article.

CULVERT FORMULAE

Designers in California use a wide variety of culvert formulae, it being common practice to apply at least two formulae for a check. Since most formulae include an arbitrary coefficient, the value of which depends upon the experience and judgment behind the selection of coefficients.

[illegible] **Fig. 1** [illegible]

[illegible] **CA** [illegible] **C** [illegible] **A** [illegible] **n** [illegible] **n** [illegible] 0.75 [illegible] **C** [illegible] Wadsworth [illegible] Sierra streams

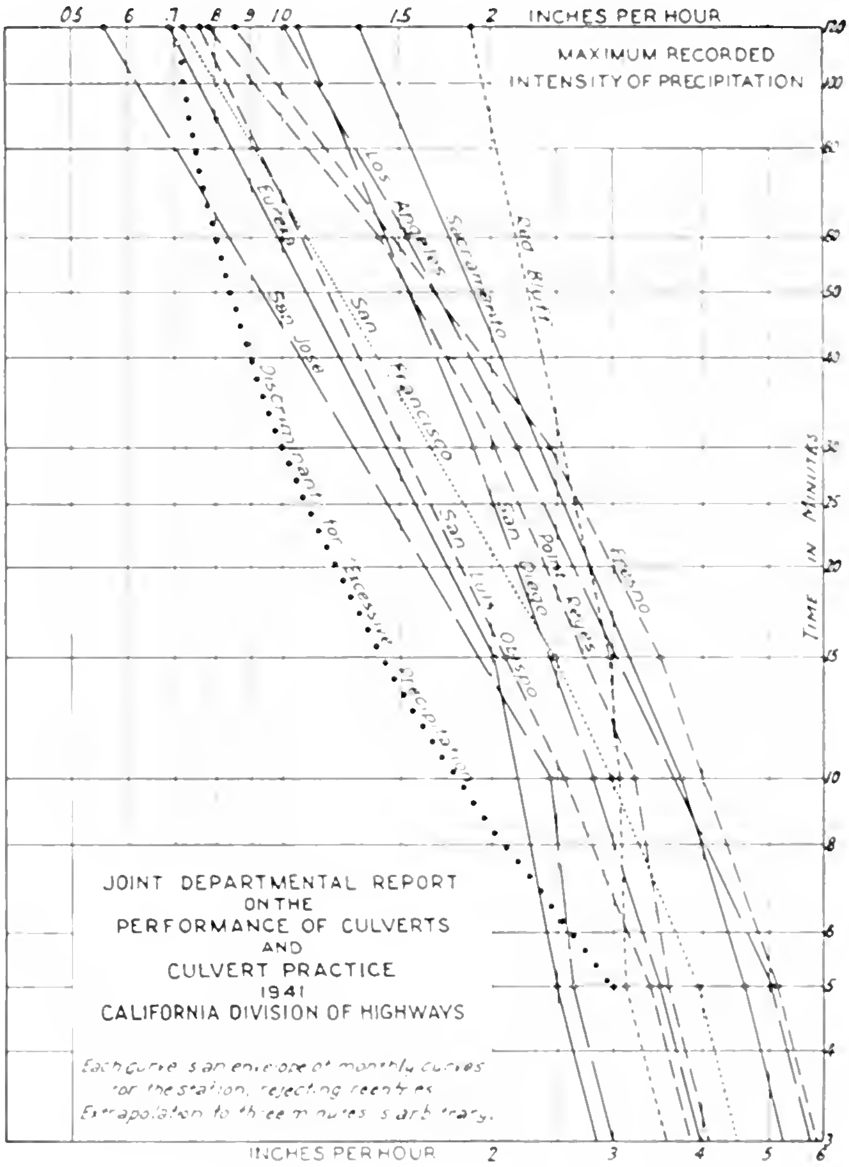


Figure 4. Maximum intensity of rainfall at ten California gages

in 1907; recent studies by the Bridge Department confirm it generally for northern California, but find **n** = 0.70 for southern California.

Several writers have analyzed Talbot's formula and found that it should pass a 10-year flood with an entrance velocity of 10 feet per second. Referring to the table, it is evident that a 100-year flood in Fuller's region would overload the culvert 11% in District III of California, 50% in District VII, etc. In the latter case, velocity through the culvert, 18 feet per second, may be tolerable, but protective appurtenances should be designed for head at entrance and turbulence at outfall. Hence, knowledge of the magnitude of 100-year floods will permit balance of designs based on Talbot's formula.

The Burkli-Ziegler formula ranks second in popularity. Procedures of this type, including a rainfall-intensity term, will gain precision with knowledge of rainfall intensity frequency. For the present, that knowledge is limited to a few urban areas, but the tremendous expansion of precipitation recorder installations a few years ago will soon be paying dividends.

FOR SMALLER AREAS

For small drainage areas, the Committee suggests comparative use of Chart A, **(Fig. 2)** to evaluate, from known effluent a judgment factor "k" which depends upon topography. The chart is a formula in nomographic form depending upon 4 measurable items (length and fall of channel from critical point on divide to site, mean rainfall-intensity for 60 minutes expected once in 100 years and area of tributary basin) to yield a design discharge (momentary peak once in 100 years).

Intermediate steps of the chart give the time of flood concentration for the basin and the mean intensity of precipitation for that concentration period. If hydrology for some particular region affords a more rational estimate of either of these factors, use of the chart may start from that point and continue through the other steps.

At the same time, **Chart A** can be used as a check method. For "k," the chart lists probable maximum values for certain types of topography. Minimum values may be smaller by 20 percentage points. For rainfall-intensity, the data now available are approximated for coastal and valley areas designated by letters **A**, **B** and **C** on a key map.

RAINFALL-INTENSITY

The most comprehensive study of rainfall-intensity frequency available is that by Yarnell (5). **Fig. 5** summarizes his 100-year frequency data for California, limited to 24-hour rainfall. For the rest of the United States, he determined like data for intense rains lasting 5, 10, 15, 30, 60, 120, 240, 480, and 960 minutes, but basic hydrology was inadequate for short-period intensities in California.

The 10 charts of **Fig. 3** were drawn in an attempt to approximate short-period intensity and are published for local interest. For each station there had been published (6) the cumulative maximum intensity of short-period precipitation by months. These were plotted by months on logarithmic scale as shown. For comparison, the lower part of the envelope of extreme intensity for each station has been forwarded on enlarged scale to **Fig. 4**.

All of these broken-line graphs show a tendency toward straight lines or very flat curves. Also the envelope curves seldom depart much from tentative frequency curves (7) shown in **Fig. 3** a-j, especially for the shorter periods. For periods typical of concentration times for culverts, it may be assumed that these envelopes are as close to 100-year expectancy as can now be foreseen.

Figure 5. Rainfall intensity—Frequency variation in the United States

Comparing the curves of **Fig. 4**, it is noticeable that envelopes for San Luis Obispo, San Jose, San Francisco and Eureka form a group of low intensity. All of these and Point Reyes are located in Area A of **Chart A**, along the north coast, the Point Reyes curve approaching the group at its ends.

A mean line for this group is represented by Point A of Scale G on **Chart A**. Similarly the San Diego and Los Angeles envelopes are related, from which Point B was plotted for the south coast. The central valley stations were represented by Point C, although the grouping was divergent each way from intersections near the 30-minute storm.

While these deductions are loosely drawn, the basic data warrant no greater precision yet. Note on **Fig. 3-e**, for example, how differently the 100-year frequency was estimated by three independent investigators, using 27, 32 and 35 years of record respectively.

Following a general survey of available hydrology pertinent to culvert practice, it was concluded that:

1. Run-off records are not and probably will not be available for culvert-size streams.
2. From records of somewhat larger streams, it may be deduced that natural laws for flood frequency in California differ materially from those for eastern United States. Particularly, the ratio of 100-year to 10-year (Fuller-type) flood may vary from 1.5 to 2.0 in California, as compared to ratios of 1.2 to 1.5 in the east.
3. Ordinary culvert formulae developed in the east should not be used in California without modification, and this modification will be far from uniform throughout the State.
4. In the past, modification has followed local experience. In the future, precipitation-intensity frequency will be available for rational modification. Tentative freqencies for limited areas warrant initiation of rational practice.
5. Designs should not depend entirely on hydrographic evidence of maximum recent flood, without consideration of the possible frequency or infrequency of that event.
6. As general rules, the Committee recommends (a) that culverts pass a 10-year flood without static head on crown of culvert at entrance, and (b) that designs be balanced for 100-year floods.

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View of broken traffic line striping equipment in operation on State highway

Broken Traffic Line Striping Machine Developed at Headquarters Shops

By DONALD H. CLARK, Jr., Mech. Engr. Draftsman

THE April, 1942, issue of this magazine publicly announced the instructions of Director of Public Works Frank W. Clark to the Division of Highways for adopting an interrupted or broken, traffic line in place of the present continuous stripe. The present solid 4-inch line will be replaced with a 3-inch broken line, while our present 3-inch triple line stripes will remain this width but be broken instead of continuous.

The basis for the broken line will be a painted stripe 15 feet in length, with a break of 25 feet. The economy of the new stripe is self-evident, resulting in a minimum annual saving to the State in paint alone amounting to approximately $90,000.

A considerable sum will also be saved by the elimination of the glass beads from the unpainted portions of the traffic stripe. The present 4-inch solid stripe requires 100 pounds of glass beads per mile at a cost of $30. These beads intensify the visibility of the painted lines and the elimination of 25 feet from the stripe in every 40 feet will amount to a saving of $18 per mile. Applying this to the mileage of beaded stripe now in existence will result in a minimum annual saving to the State of about $22,000 for beads alone. The saving in paint and beads will, therefore, amount to approximately $112,000 annually.

Up to the present time, utilization of the broken traffic line for marking highways is believed to be rather limited, even though there is a great saving in the amount of paint used. This may be due to the lack of adequate equipment to efficiently apply this type of traffic stripe.

With the extensive traffic line markings used on the highways in California, the Equipment Department believed that the need for an automatic machine to paint the interrupted stripes was imperative.

Upon inquiry and extensive correspondence, the New York State Department of Public Works gave valuable aid through Charles R. Waters, District Engineer. Their experiences in painting the broken line resolved into the development of an automatic machine, thereby substantiating our desire for this type of equipment. With the conditions prevailing today, the possibility of procuring commercially-made valves such as used by Mr. Waters seemed too uncertain to attempt a reproduction of the New York machine.

With these conditions being determined, the writer developed a new machine to automatically paint the interrupted traffic stripe and Head-

quarters Shop of the Division of Highways manufactured all basic parts which could not be procured from available supplies.

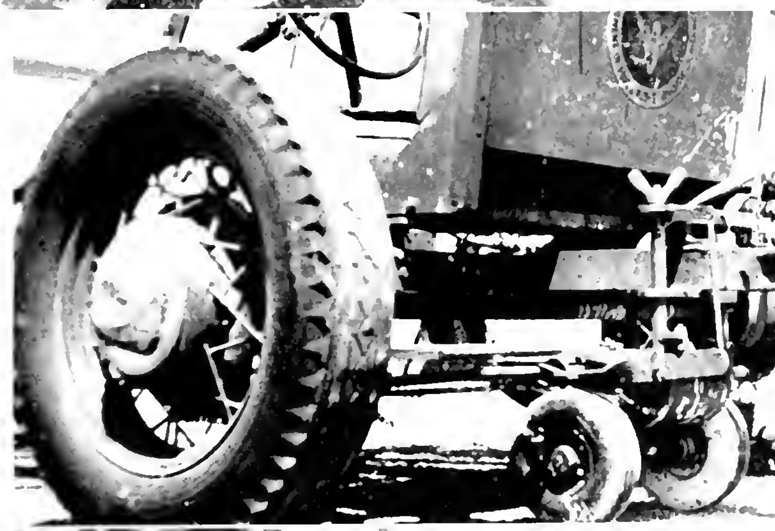
Fundamentally, the new device is an air-control attachment to be mounted directly on the paint striping machines now operated by the Division of Highways. The coordination and synchronization of the paint spray guns and the glass bead dispenser are accomplished by a rotary disc type of air valve, as illustrated in the accompanying photos. This valve is driven by a variable ratio mechanism so as to compensate for different field conditions, enabling the operator to maintain a cycle length of 40 feet and to restripe.

The outer ring of the rotary valve controls the compressed air supply to the paint spray gun actuating air ram, which in turn operates the needle valve to turn the spray on and off.

The inner disc contains the valve to control the air supply to the bead dispenser air lift which may be adjusted to the proper relationship with the outer disc to synchronize the application of the glass beads to the painted portion of the traffic stripe.

As the wheels of the dispenser are lifted clear of the road surface by the air lift, which was designed for the type of dispenser in use, they come in contact with a brake to stop the feeding of the beads at the end of the painted interval of the line.

(Continued on page 14)



Top—Bicycle wheel operates attached cylindrical interrupter valve. Center—Rear view showing bead applicator mechanism. Bottom—Paint and air controls to spray guns

July Traffic Study Count Shows 17.7 Per Cent Drop Below Last Year

By C. H. PURCELL, State Highway Engineer

THE 1942 annual traffic count taken on Sunday and Monday, July 12th and 13th, reveals a sharp reversal in the long continued upward trend in the volume of motor vehicle traffic on our highways. In contrast with the 1941 count, which recorded an increase of 10.8 per cent over 1940, we find that July traffic in 1942 has declined to a point 17.7 per cent below last year's record volume.

This decrease is not unexpected, since our regularly occupied monthly key stations show the downward trend as having begun in March of this year.

The decreases are found not only in every main group of routes but practically every one of the eighty individual routes which form the basis for these comparisons likewise shows losses in traffic carried.

The only exceptions where gains over 1941 were recorded for both Sunday and Monday are Routes 14 and 74 in Contra Costa and Solano counties, which gains undoubtedly were brought about by the large expansion of industrial activity in that area.

It will be noted that the largest decrease is recorded by the recreational group. While the routes which comprise this group serve recreational areas, the traffic which they carry is of course only partially concerned with recreation.

No change was made from the regular procedure of previous years in the manner of taking the count. Actual recording covers the 16-hour period from 6 a.m. to 10 p.m. for both Sunday and Monday. Traffic was segregated by hourly periods into the following vehicle classifications: California passenger cars, out-of-State passenger cars, buses, light trucks, heavy trucks, trailers drawn by trucks, trailer coaches, and other passenger car trailers.

Each year some minor changes in the census become necessary, such as the relocation, addition, or discontinuance of individual stations; but in every instance these are excluded when determining comparisons with the previous year, only those stations that were identical during both years being taken into consideration.

These comparisons for the various route groups are as follows:

PER CENT GAIN OR LOSS FOR 1942 COUNT AS COMPARED WITH 1941

	Sunday	Monday
All Routes	—20.23	—17.05
Main North and South Routes	—20.51	—18.91
Interstate Connections	—19.78	—14.70
Laterals Between Inland and Coast	—18.08	—12.76
Recreational Routes	—28.26	—25.04

The gain or loss of traffic volume for State Highway Routes 1 to 80 inclusive, which constitute the basis for the foregoing summary, is shown in the following tabulation:

Route	Termini	1942 Per cent gain or loss			
		Sunday		Monday	
		Gain	Loss	Gain	Loss
1.	Sausalito-Oregon Line		24.73		26.49
2.	Mexico Line-San Francisco		20.87		21.37
3.	Sacramento-Oregon Line		8.78		2.40
4.	Los Angeles-Sacramento		23.08		21.05
5.	Santa Cruz-Jc. Rt. 65 near Mokelumne Hill		20.86		12.89
6.	Napa-Sacramento via Winters		20.04		18.43
7.	Crockett-Red Bluff		16.18		10.80
8.	Ignacio-Cordelia via Napa		18.52		11.56
9.	Rt. 2 near Montalvo-San Bernardino		22.00		17.28
10.	Rt. 2 at San Lucas-Sequoia National Park		18.83		14.88
11.	Rt. 75 near Antioch-Nevada Line via Placerville		18.94		11.12
12.	San Diego-El Centro		15.77		20.56
13.	Rt. 4 at Salida-Rt. 23 at Sonora Jc.		39.81		35.34
14.	Albany-Martinez	6.78		17.70	
15.	Rt. 1 near Calpella-Rt. 37 near Cisco		21.31		10.90
16.	Hopland-Lakeport		25.34		22.55
17.	Rt. 3 at Roseville-Rt. 15, Nevada City		30.92		33.57
18.	Rt. 4 at Merced-Rt. 40 near Yosemite		32.94		36.80
19.	Rt. 2 at Fullerton-Rt. 26 at Beaumont		20.73		13.18
20.	Rt. 1 near Arcata-Rt. 83 at Park Boundary		25.17		17.76
21.	Rt. 3 near Richvale-Rt. 29 near Chilcoot via Quincy		27.72		25.67
22.	Rt. 56, Castroville-Rt. 29 via Hollister		31.90		25.49
23.	Rt. 4 at Tunnel Sta.-Rt. 11, Alpine Jc.		23.57		22.60
24.	Rt. 4 near Lodi-Nevada State Line		34.48		25.00
25.	Rt. 37 at Colfax-Rt. 83 near Sattley		20.61		27.70
26.	Los Angeles-Mexico via San Bernardino		17.67		13.20
27.	El Centro-Yuma		15.45		15.43
28.	Redding-Nevada Line via Alturas		26.07		19.82
29.	Peanut - Nevada Line near Purdy's		26.78		15.76
31.	Colton-Nevada State Line		15.55		18.74
32.	Rt. 56, Watsonville - Rt. 4 near Califa		31.00		25.33
33.	Rt. 56 near Cambria-Rt. 4 near Famoso		42.61		36.50
34.	Rt. 4 at Galt-Rt. 23 at Pickett's Jc.		35.47		24.64
35.	Rt. 1 at Alton-Rt. 20 at Douglas City		20.49		12.41
37.	Auburn-Truckee		36.40		33.49
38.	Rt. 11 at Mays-Nevada Line via Truckee River		39.00		39.31
39.	Rt. 38 at Tahoe City-Nevada State Line		38.95		41.75
40.	Rt. 13 near Montezuma-Rt. 76 at Benton		49.84		43.44
41.	Rt. 5 near Tracy-Kings River Canyon via Fresno		33.43		21.55
42.	Redwood Park-Los Gatos		36.83		27.20
43.	Rt. 60 at Newport Beach-Rt. 31 near Victorville		15.55		9.89
44.	Boulder Creek-Redwood Park		31.73		36.40
45.	Rt. 7, Willows-Rt. 3 near Biggs		18.23		34.46
46.	Rt. 1 near Klamath-Rt. 3 near Cray		27.68		38.59
47.	Rt. 7, Orland-Rt. 29 near Morgan		15.36		15.53
48.	Rt. 1 N. of Cloverdale-Rt. 56 near Albion		34.42		21.61
49.	Napa-Rt. 15 near Sweet Hollow Summit		23.96		22.00
50.	Sacramento-Rt. 15 near Wilbur Springs		31.11		25.52
51.	Rt. 8 at Schellville-Sebastopol		19.82		16.16
52.	Alto-Tiburon		7.74		11.74
53.	Rt. 7 at Fairfield-Rt. 4 near Lodi via Rio Vista		13.56		20.71
54.	Rt. 11 at Perkins-Rt. 65 at Central House		37.17		32.42
55.	Rt. 5 near Glenwood-San Francisco		37.01		38.00
56.	Rt. 2 at Las Cruces-Rt. 1 near Fernbridge		27.81		23.66
57.	Rt. 2 near Santa Maria-Rt. 23 near Freeman via Bakersfield		38.17		33.86
58.	Rt. 2 near Santa Margarita-Arizona Line near Topock via Mohave and Barstow		25.78		20.79
59.	Rt. 4 at Gorman-Rt. 43 at Lake Arrowhead		11.54		1.13
60.	Rt. 2 at Serra-Rt. 2 at El Rio		18.42		17.05
61.	Rt. 4 S. of Glendale-Rt. 59 near Phelan		19.78		19.91
62.	Rt. 171 at Northam-Rt. 61 near Crystal Lake		32.02		17.28
63.	Big Pine-Nevada State Line		4.92	5.56	
64.	Rt. 2 at San Juan Capistrano-Blythe		0.79	23.17	
65.	Rt. 18 near Mariposa-Auburn		33.06		33.43
66.	Rt. 5 near Mossdale-Rt. 13 near Oakdale		21.11		16.35
67.	Pajaro River-Rt. 2 near San Benito River Bridge		29.05		5.27
68.	San Jose-San Francisco		22.23		18.79
69.	Rt. 5 at Warm Springs-Rt. 1, San Rafael		4.32		5.59
70.	Ukiah-Talmage		9.28		8.76
71.	Crescent City-Oregon Line		54.78		53.01
72.	Weed-Oregon Line		51.21		52.94
73.	Rt. 29 near Johnstonville-Oregon Line		46.65		35.62
74.	Napa Wye-Cordelia via Vallejo and Benicia	13.95		15.80	
75.	Oakland-Jc. Rt. 65 at Altaville		13.37		3.50
76.	Rt. 125 at Shaw Ave.-Nevada State Line near Benton		38.75		20.01
77.	San Diego-Los Angeles via Pomona		14.02		2.29
78.	Rt. 12 near Descanso-Rt. 19 near March Field		34.34		20.71
79.	Rt. 2, Ventura-Rt. 4 at Castaic		21.13		9.71
80.	Rt. 51, Rincon Creek-Rt. 2 near Zaca		40.43		37.21

Sketch showing location of California State Maritime Academy at Morrow Cove near Vallejo and barracks and school buildings now under construction

Governor Olson Supplies Funds For Buildings At Maritime Academy Base

By ANSON BOYD, State Architect

WITH funds furnished by Governor Olson from his depleted Emergency Fund, the temporary shore base construction for the California State Maritime Academy is now being built along the beach at Morrow Cove about two miles east of Vallejo.

The wood frame barracks-type dormitories and instructional buildings can be seen taking shape against the dark background of the eucalyptus grove which lies just west of the Carquinez Bridge toll-house and overlooking Carquinez Straits.

BARRACKS UNDER CONSTRUCTION

The buildings will house the cadet companies of this State merchant-marine training school whose graduates with their rank of naval reserve ensign are in urgent demand as deck and engineer officers for the ships being launched daily from California's shipyards.

Included in this project for which the sum of $160,000 was allocated from the Governor's Emergency Fund are temporary barracks containing toilet and shower rooms in which the cadets, assigned four men to a squad room will live during the concentrated 16-month period of their training except during the two protracted cruises on the ship "Golden State."

To be constructed also is a T-head timber wharf, 200 feet in length along each leg, which is the home berth of this training-ship assigned to the State of California by the United States Maritime Commission, and which also provides for the ship's overhauling. Adjoining the dormitories and arranged around a small quadrangle facing the cove are a classroom and administration building, kitchen and mess hall seating 200 cadets and an engineering shop and instructional building, all of which are of minimum critical material, "duration" construction to house an urgency needed facility.

The program proposes the installation of water, gas, and electric power services which are scheduled, with the building structures, for completion during the latter part of September, 1942, and for which a high preferential priority was granted by the War Production Board, upon the request of the State Department of Public Works.

Central Valley Project Power Assured in 1944 by New Priorities

THE growing importance of Central Valley Project power to California's war production program was cited by Director of Public Works Frank W. Clark in announcing receipt of word from Washington, D. C., that new and higher priority ratings had been issued for Shasta and Keswick dams.

"These new priority ratings, assuring that Central Valley Project power will be on the line in 1944 come as welcome news to California," Clark said. "When the Federal Government announced it was transferring two of the generators fabricated for the Shasta power plant to Grand Coulee, the future of the Central Valley Project appeared very uncertain.

NEW GENERATORS PROVIDED

"At the same time efforts of the power companies to block construction of the transmission lines for the project lead to great concern on the part of the State administration. This concern was so deep that Governor Olson made a trip to Washington especially to confer with Government officials and California Congressmen on the matter.

"Due in large part to the showing made by the administration, the appropriations for the transmission lines and steam electric plant were passed by the Congress. Now with the assurance that the generators will be on the line when the dams are completed, the Central Valley project can take its needed place in California's war effort."

KESWICK COMPLETION CONTRACTED

In announcing the new priority ratings for the Shasta and Keswick plants, the War Production Board said that two large generators of 75,000 kilowatts each would be installed by January, 1944, and a third of the same capacity by March of that year. At Keswick two generators of 25,000 kilowatts each are scheduled to be in operation in May and June of 1944.

Close on the heels of the War Production Board announcement came word from Secretary of the Interior Harold Ickes that he had approved a negotiated contract for the completion of Keswick Dam. The Atkinson-Kier Construction Company which has been building the foundations of the dam was awarded an emergency change-order authorizing it to bring Keswick Dam up to full height and complete the powerhouse to the generator floor stage. Amount of the change order was $1,492,946.

Architecture Division Wins High Praise

At the last regular meeting of the Board of Directors of the San Diego Chamber of Commerce, the following resolution was unanimously approved:

"Be it resolved by the members of the Engineering Committee of the San Diego Chamber of Commerce

"That we endorse the current policy of the California State Division of Architecture of approving methods of design and construction of school buildings, that will within the recognized limits of safety and economy permit the use of available materials of construction nonessential to the war effort.

"That we wish to commend the personnel of the State Division Architects for their cooperation in conferring with, and advising school board representatives, architects and engineers, on details of design and construction that will accomplish the above,

"And that we believe much benefit can be gained by the publication and distribution of current approved methods of design and construction to persons responsible for the planning and design of school buildings, so

"Be it therefore resolved that it is our desire that this resolution be approved by the Board of Directors of the San Diego Chamber of Commerce and that copies be forwarded to the California State Division of Architecture."

Very truly yours,

SAN DIEGO CHAMBER OF COMMERCE,

(Signed) By John T. Martin, President.

Donors of Property For Access Road Thanked by State

THE Division of Highways reports that it has been granted gratuitously certain property, rights of way and road building material for the construction of a military access road in Kern County. In reporting the gift, State Highway Engineer C. H. Purcell said:

"In acknowledgment of the wholehearted cooperation of various parties to the gift the division extends its thanks and appreciation to the following for their part in furthering a vital war effort:

"Grace Canale, Nicholas Canale, Chanslor Canfield Midway Oil Company, Dorothy Fried, Julius Fried, General Petroleum Corporation, George Hay Corporation, Merritt Annex Oil Co., The Norwalk Co., Pacific Gas and Electric Co., Southern California Gas Co., Standard Oil of California, Sunset Western Railroad, The Texas Co., Tide Water Associated Oil, Union Oil, Western Water Co., Wilshire Annex Oil Co.

"The property thus acquired includes six miles of road 80 to 100 feet wide; more than 50 acres including producing oil field and grazing land; nearly 200,000 yards of road building material and more than 30 separate oil, gas and water pipe lines involved. No permits for occupation were required and no condemnation suits were necessary."

North Sacramento Viaduct Officially Opened to Traffic

Two lanes of the Sacramento-North Sacramento viaduct, which provides an all-year highway between the two cities over the flood water area of the American and Sacramento rivers and two railroads, were opened to traffic on September 14 as this issue of the magazine goes to press. State, county, and city officials and representatives of Sacramento Chamber of Commerce and other civic bodies officiated at the opening. The total cost of the viaduct was $631,000, financed with State and Federal Aid funds.

Further details of the dedication ceremonies and engineering and construction features of the viaduct will be printed in our October issue.

Simplified Method of Making Traffic Flags For Use on Highways

FOR some time past, Superintendent T. W. Martin, Division of Highways, Whittier, California, has been working on improvements to speed up the construction of wire frame holders for red flags used for the protection, during drying, of newly painted center stripe or pavement markings. The latest development is an ingenious device which is unquestionably a time and labor saving method.

The wire can be shaped, both loops closed and a flag tied in about a minute and a half. This results in a flag of uniform size and appearance.

Flags of two different sizes are being observed for visibility to traffic, and ability to withstand air suction of passing vehicles.

Illustrations of the procedure are described as follows:

Fig. 1. Using a short section of pipe of about 8 inch in diameter which is welded to a longer section of 3 inch pipe, as a jig, the wire is pushed into a hole to a depth of about ¾ inch. Then the wire is bent at right angles to form the loop which will be closed to tie to the upright. After pushing the wire into the hole it is wrapped around the pipe making a circle of about 8 inches in diameter.

Fig. 2. This shows the completion of the circle and in Figure 3 the upright portion is bent around a screw fastened to the pipe. To make a sharp bend the wire is lowered between this screw and the head of a bolt, which can not be seen, directly behind the screw.

Fig. 4. The wire has been removed and the top loop, which will hold the flag, is being bent in the hole used for the lower loop.

Fig. 5. The upright is being bent into the center of the circle so that the flag will stand on the highway without turning over.

Fig. 6. The lower and upper loops have been closed in the standard on the right and a flag has been tied to the other two standards shown.

A. M. Nash Appointed District Engineer of Highway District I at Eureka

A. M. NASH, who has been serving in various engineering capacities in the Division of Highways for the past 22 years, has been appointed District Engineer of District I, with headquarters at Eureka, succeeding the late E. R. Green.

Mr. Nash entered the employ of the Division of Highways in January, 1920, as an engineering draftsman in central office at Sacramento. In January, 1924, when District X at Stockton was first organized he was transferred to that district as chief draftsman and remained there employed in both field and office work until 1934, when he was again transferred to the central office in Sacramento as assistant office engineer.

He remained in this position and later as assistant engineer of surveys and plans until February, 1942, when he was transferred to District IV in San Francisco as assistant district engineer.

Mr. Nash was born at Elk City, Kansas, and was educated in the schools of Kansas and Idaho and at the University of Washington. Previous to entering the employ of the State of California, he worked for the Idaho Highway Department, the Great Northern and Oregon Shortline railroads and the Interstate Commerce Commission.

He enlisted in the last World War in the Aviation Section, Signal Reserve Corps and was commissioned Second Lieutenant and Aviation Pilot, serving at March Field, California. At the termination of his Army service in February, 1919, he was employed by the California Department of Engineering and Irrigation as Chief of Party in Sacramento, which position he resigned to take employment with the Division of Highways.

A. M. NASH

Mr. Nash is married and has two daughters aged 16 and 14.

New Rio Vista-Lodi Cut-off Saves 10 Miles

(Continued from page 2)

Although county authorities took the matter in hand and immediately started the work of repairing this bridge, had not this new section of highway been completed and open to traffic, a detour 10 miles longer than the old route or 20 miles longer than the new route would have been necessary.

There are four bridges on the former portion of State highway route now reverted to the counties: three movable type bridges located at Georgiana Slough, Miller's Ferry, and New Hope Landing, and one fixed type bridge at Beaver Slough. On the new route there are four bridges: two movable type bridges located at Mokelumne River and Potato Slough, and two fixed type bridges, one west of Potato Slough (trestle) and a small one at Woodbridge Irrigation Canal near Lodi.

The Rio Vista cut-off has been accomplished by several construction projects including a new bridge across Potato Slough at Terminous with approaches thereto constructed in 1937 by Bodenheimer Construction Company at a cost of $213,100.

At the westerly end of Potato Slough Bridge and extending thence west about one-half mile, a test road installation was placed using sand drains and fills, which work was done in 1940 by Mike Malfitano and Son at a cost of $25,100.

From the Potato Slough Bridge to a point west of the Mokelumne River connecting with the county road, a distance of 5.0 miles, grading with necessary vertical drains has recently been completed by Clyde Wood Construction Company at a cost of $293,800.

The new bridge across the Mokelumne River has been completed by the Tavares Construction Company at a cost of $368,000.

The existing county road being used temporarily as a State highway routing between the westerly end of the completed construction west of the Mokelumne River to Isleton, a distance of 3.6 miles, was touched up and conditioned by State forces at an expenditure of $2,500.

The above indicates construction expenditures to date of $900,000.

Four-Lane Divided Highway Reduces Traffic Hazard

(Continued from page 4)

pneumatic tired truck roller was used. After final rolling a curing seal of asphaltic emulsion was applied.

The cement treated base was placed to a compacted thickness of six inches. An asphalt concrete surface was then placed over the base to a three inch compacted thickness. The asphaltic mixture was hauled from the contractor's plant at Banning in dump trucks. After delivery to the street the material was handled in a manner very similar to that used for the cement treated base. It was spread through the self-propelled spreading machine operating on the base without the use of headerboards. The heavy three-axle roller was used for compaction and finish rolling was performed with a tandem roller operating longitudinal with the pavement. Cross rolling was not required.

A penetration treatment using liquid asphalt, SC-2, was applied to shoulder areas.

The war trend is discernible in the type of traffic stripe used which consists of a dashed line that is of narrower width than the pre-war standard. This Victory stripe is designed to conserve paint ingredients.

The work was performed under the supervision of R. A. Bergman, Resident Engineer.

Procedure and Factors Governing Issuance of Truck Overload Permits

(Continued from page [illegible])

The gross load can be increased when it is practicable to make certain that the operation of a particular vehicle can be controlled, such as traveling along the centerline of the bridge and at slow speed.

Since general provisions must take into account the effect of repeated heavy loads (a structural member of a bridge or a load surface will fail under much lower stresses than a single load would cause if the loading is repeated frequently), it is only practicable to grant permits for very occasional loads that exceed the legal maximum weight. This, for obvious reasons, is only permissible in emergencies—that is, under circumstances that are only likely to occur at very long and infrequent intervals.

It is the duty of the Division of Highways of the Department of Public Works to determine when a road or bridge can stand an occasional load heavier than the law permits, and also when and how much the legal loading must be reduced because of structural weakness or bad condition. These decisions are strictly a matter of engineering calculations and judgment, and the engineers of the Highway Department have always advocated a policy of allowing the maximum loads consistent with the engineering principles governing the safe stress in road pavements or bridges.

SOME VARIANT FACTORS

The public should realize that reduced revenues, restrictions on construction materials and equipment, repairs or replacements, shortage of labor—all make it difficult to maintain the roads in their normal condition. In consequence, more frequent posting of highways and bridges and stricter limitations on overweight vehicles become necessary.

The procedure under which legal load limits can be reduced is covered by Sections 715 and 715.5 of the Vehicle Code and involves an engineering investigation, a public hearing to consider the recommended posting, and the placing of proper signs on the highway. The driver of a vehicle carrying a heavier load than that set forth in Sections 704 and 705 of the code, or heavier than load limits which have been reduced in accordance with Sections 715 and 715.5, must have a special permit or reckon with the Highway Patrol.

Section 710 of the code covers the issuing of an overweight permit by the Department of Public Works. For the convenience of haulers and for better control of the vehicle movement, application for an overweight permit is made at the nearest Highway District Office. All these offices have information showing the safe load capacity of structures on various sections of the highway and the proportionate increase in the legal weight restrictions that can be allowed when the operation of the vehicle is properly controlled.

Unusual or borderline conditions may have to be taken up with the Sacramento office but this can be done by telephone or by wire if the time is short and delay is serious. If an overweight permit can be justified it will be issued by the District Engineer.

Haulers can prevent unnecessary delay to themselves by having an accurate description of their vehicle or vehicles. This means, primarily, the axle spacings and their actual weights. The gross load and the relative axle weights under similar loading conditions are usually sufficient to cover the latter data and many concerns have furnished the Highway Department with a description of their equipment, in which case it is only necessary to refer to the particular vehicle and give its gross load.

The applicant for a permit must also get the government officials to certify by letter or wire that the movement of this particular load is required in connection with the war effort. Finally, it is requested of applicants as a favor to the engineer who is trying to give the best service he can, sometimes under trying circumstances, that they try to give at least a few hours notice before a permit is needed and not expect that the laws of nature can be entirely ignored, even if it is a National emergency.

Broken Traffic Line Striping Machine Developed at Shops

(Continued from page [illegible])

When applying the interrupted stripe, the painted interval of the line will be applied first, which will be 15 feet in length, and will be followed by a 25-foot space, giving a cycle length of 40 feet.

To accomplish this, a synchronizing pointer is set at the point of beginning the line, the mechanism is engaged by a hand lever, and the interrupted stripe is then automatically laid down while the machine progresses over the highway. When it is desired to stop the painting process, this is accomplished by turning a hand valve, or by disengaging the air valve driving mechanism shifting lever, depending upon the station in the cycle at which the line is to terminate.

Variations in the tire air pressure and the desirability of matching a new stripe with an old one when restriping and the beginning of the stripe at a particular point necessitated a degree of flexibility in the mechanism. A period adjustment is provided that changes the length of the cycle while in motion if the operator so desires.

There will be times when it will be necessary to make a break in the cycle length of 15 feet of painted line and 25 feet of interrupted space, such as when striping up to a cross-over or other interruption in the established marking. When this situation is encountered, the machine may be changed from automatic to hand control simply by turning a hand valve, converting the machine to its original type.

The operation of the striping machine with the automatic interrupting mechanism can be carried out at the accustomed speeds and in the usual manner. Single lines with or without beads may be painted, as well as multiple line stripes with or without beads.

There are twelve painting machines in operation throughout the State, each requiring a skilled operator, and the mechanism was devised by the writer to function under the varying field conditions and with a minimum number of controls, having in mind the efficient operation of the paint striping machines.

Highway Bids and Awards for the Month of August, 1942

CONTRA COSTA COUNTY—Between 1½ miles west and ¼ mile east of Glenn Frazer Station, about 1.9 miles to be graded, surfaced with imported borrow and armor coat constructed thereon. District IV, Route 106, Section A. Contract awarded to N. M. Ball Sons, Berkeley, $323,145.

KERN COUNTY—Between Fort Tejon and 14 miles north of Grapevine Station, about 6.0 miles to be widened with portland cement concrete pavement and plant-mixed surfacing to be placed. District VI, Route 4, Section A. Contract awarded to Griffith Co., Los Angeles, $384,951.

LOS ANGELES COUNTY—Across Los Cerritos Channel about 6 miles east of Long Beach, a timber bridge to be constructed. District VII, Route 179, Section A. Carlo Bongiovanni, Los Angeles, $19,333; Byerts & Dunn, Los Angeles, $19,931; R. M. Price, Huntington Park, $24,648. Contract awarded to E. G. Perham, Los Angeles, $17,092.

LOS ANGELES COUNTY—Through Hermosa Beach on Sepulveda Blvd. about 1.3 miles to be widened and paved with asphalt concrete and portland cement concrete. District VII, Route 60, Section HmB, Rdo B. Oswald Bros., Los Angeles, $99,385. Contract awarded to Griffith Co., Los Angeles, $76,861.

MODOC COUNTY—Removing four timber bridges and constructing three timber bridges and installing one corrugated metal pipe culvert between 9½ miles and 13 miles north of Alturas. District II, Route 73, Section A. J. P. Brennan, Redding, $5,781; C. C. Gildersleeve, Colusa, $6,535; California Paving Co., San Mateo, $7,650; L. C. Smith, San Mateo, $7,807. Contract awarded to Jack Gilmore, Redding, $4,978.

SAN DIEGO COUNTY—Across Boat Channel in San Diego City, a timber, concrete and structural steel bridge to be constructed. District XI. R. E. Hazard & Sons, San Diego, $346,275; Byerts & Dunn, Los Angeles, $382,417. Contract awarded to Ralph A. Bell, Eureka, $341,479.

SAN DIEGO COUNTY—In the city of San Diego on Harbor Drive between Civic Center & Rosecrans Street, about 3.7 miles to be graded and paved with portland cement concrete. District XI. R. E. Hazard & Sons, San Diego, $492,870; V. R. Dennis Construction Co., San Diego, $523,575. Contract awarded to Ralph A. Bell, Eureka, $459,899.

SAN DIEGO COUNTY—On Rosecrans Street and Mission Valley Road, between Lytton St. and Sixth St. extension, about 3.5 miles to be graded and paved with portland cement concrete and asphalt concrete. District XI. Ralph A. Bell, Eureka, $746,073. Contract awarded to R. E. Hazard & Sons, San Diego, $712,918.

SAN DIEGO COUNTY—On Eighth St. and Harbor Drive, between Roosevelt St. in National City and G St. in San Diego, about 4.7 miles to be graded and paved with asphalt concrete and portland cement concrete. District XI. South Harbor Drive. R. E. Hazard & Sons, San Diego, $797,093; Griffith Co., Los Angeles, $822,585. Contract awarded to V. R. Dennis Construction Co., San Diego, $694,167.

SAN LUIS OBISPO COUNTY—Between Santa Margarita and northerly boundary, about 28.8 miles to be resurfaced with plant-mixed surfacing. District V, Route 2, Sections C.B.A. W. E. Hall Co., Alhambra, $324,265. Contract awarded to A. J. Raisch, San Jose, $264,738.

SANTA BARBARA AND SAN LUIS OBISPO COUNTIES—At various locations, seal coat to be applied for a distance of 6.8 miles. District V, Route 2, Sections G.F.E. Contract awarded to Brown, Doko and Baun, Pismo Beach, $14,690.

SISKIYOU COUNTY—Between Edgewood Road and 4.0 miles north, about 3.8 miles to be graded and surfaced with plant-mixed surfacing. District II, Route 72, Section A. Contract awarded to Poulos & McEwen, Sacramento, $83,317.

SOLANO COUNTY—A bridge across Napa River at west city limits of Vallejo to be repaired and a new concrete deck constructed. District X, Route 208, Section A. E. E. Smith, El Cerrito, $292,950; A. Teichert & Son, Inc., Sacramento, $345,088. Contract awarded to Trewhitt-Shields and Fisher, Fresno, $247,865.

In Memoriam

Everett R. Green

May 9, 1887 - July 25, 1942

To his numerous friends among the officials and fellow employees of the California State Division of Highways, the sudden passing of Everett R. Green, District Engineer of District 1 with headquarters in Eureka, came as a shock. His death occurred at a hospital on July 25th following a heart attack on the previous day.

Mr. Green was born May 9, 1887, at Oregon City, Oregon. He received his schooling at Oregon City High School and at Oregon Agricultural College.

His first work was railroad engineering in the northwestern States and in Alaska. His first employment on highway work was with the Oregon State Highway Department in 1914. He was with the Oregon Highway Department from 1914 to 1917. From November 1917, to June 1919, he served with the 23d Engineers, U. S. Army in France. After the war he returned to the Oregon Highway Department where he stayed until June 1922, at which time he accepted employment with the U. S. Bureau of Public Roads, District 1, at Portland, Oregon. He was with the Bureau until September 1928. His experience with the Oregon Highway Department and with the U. S. Bureau included all phases of highway location and construction.

In 1928 he became affiliated with the Division of Highways of the Department of Public Works. He served first as maintenance engineer, then as construction engineer, at San Luis Obispo until 1938, when he was appointed district engineer at Eureka.

He is survived by his mother, Mrs. Mary Green of Detroit, Michigan; his wife, Frances; and children, Eris, Bonnie Lee and Patsy Ann; and five brothers and sisters, Grylam Green, Mrs. Alvin Sheppart and Mrs. Anna Talbot of Oregon City; Herbert Green of Clinton, Washington; and Mrs. Gladys Scott of Detroit.

Bids and Awards for July, 1942

SAN MATEO COUNTY—Near Half Moon Bay, area to be graded and a portion thereof to be surfaced with plant-mixed surfacing. District IV. Chas. L. Harney, San Francisco, $458,431; Marshall S. Hanrahan, Redwood City, $561,005. Contract awarded to Macco Construction Co., Oakland, $394,878.

SANTA BARBARA COUNTY—At various locations, about 6 miles in length, portions of existing roadbed to be repaired with plant-mixed surfacing and seal coat. District V, Routes 2, 56, 149, Sections KEDC, AB,A. Contract awarded to L. A. Brisco, Arroyo Grande, $49,788.

VENTURA COUNTY—At Beetox, over Beardsley Channel, about 0.5 mile in length, a reinforced concrete box culvert to be constructed, approaches thereto to be graded and paved with Portland cement concrete. District VII, Route 2, Section C. Carlo Bongiovanni, Los Angeles, $66,362. Contract awarded to Vido Kovacevich, South Gate, $61,459.

YOLO COUNTY—Near Winters, surface area and related approach roads to be graded and surfaced with plant-mixed surfacing on gravel base. District III. Fredrickson & Watson Construction Co., Fredrickson Bros., Oakland, $573,367. Contract awarded to Fredericksen & Westbrook, Sacramento, $54,848.

YUBA COUNTY—Between Linda Corners and Camp Beale, about 7.9 miles to be graded and surfaced with crushed gravel base and plant-mixed surface. District III, Route 3, Section B. A. Teichert & Son, Inc., Sacramento, $519,507; Fredericksen & Westbrook, Sacramento, $615,454. Contract awarded to Hemstreet & Bell, Marysville, $476,224.

Pedestrians Deaths In United States Number a Third of Traffic Fatalities

Motor vehicle accidents throughout the United States killed 13,600 pedestrians and injured 265,000 during 1941—one-third of all traffic deaths, and almost one-fifth of all injuries, according to official reports.

The 1941 pedestrian death toll was 7 per cent greater than the 1940 figures. Nonpedestrian deaths, however, rose 21 per cent. In the last 10 years, the report disclosed, pedestrian deaths have increased 2 per cent, while nonpedestrian deaths were rising 30 per cent.

State of California

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Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

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ROBERT H. ROOT, Assistant Director

MORGAN KEATON, Deputy Director

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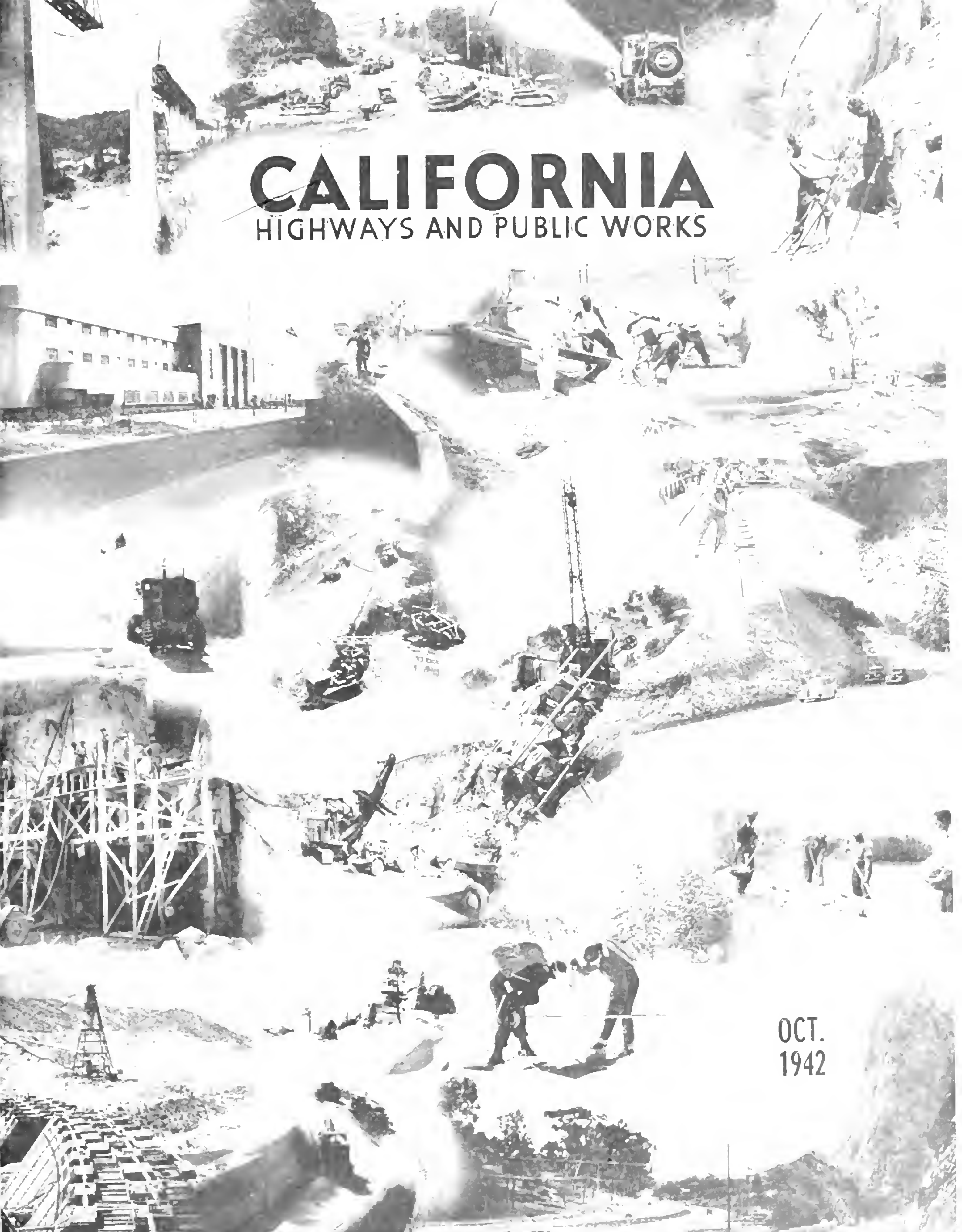

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CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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FRANK W. CLARK, Director C. H. PURCELL, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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Vol. 20 OCTOBER, 1942 No. 10

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Governor Olson Issues Executive Order Ratifying Regulations for Pooling all State-owned Automobiles

FINAL plans for the pooling of State-owned passenger cars to conserve rubber have been completed by the special committee appointed for this purpose by Governor Olson and a letter setting up rules and regulations to govern the use of State automobiles has been sent to all departments, boards, commissions, institutions, teachers colleges, and special schools.

The committee acted under an executive order issued by Governor Olson and under powers delegated to it by the Governor on August 20th. The committee is composed of Director of Public Works Frank W. Clark, Chairman; Director of Finance George Killion, and Director of Motor Vehicles James M. Carter.

MANY CARS GROUNDED

Pending the drafting of rules and regulations, several agencies, notably the Department of Public Works, Department of Agriculture, and Department of Motor Vehicles, have grounded many of their passenger cars.

Each State agency will be required to immediately set up a department pool with such subpools as may be necessary. No State automobile shall be used for other than vital public service and shall be used only when other forms of transportation are not available.

Administration of the pool will be under direction of a coordinator of State automobile conservation with headquarters in the Public Works Building, Sacramento.

35 MILE SPEED LIMIT

Coincident with the forming of the State automobile pool, Governor Olson on September 30th, issued a proclamation in response to a request from Joseph B. Eastman, National Director of Defense Transportation, authorizing the Director of the Department of Motor Vehicles to enforce the 35 mile speed limit for passenger automobiles, trucks and buses.

"As Governor of the State of California and Chairman of the State Council of Defense," Governor Olson said in issuing the proclamation, "I urge full compliance with the Government's speed limit order by every citizen of this State, and I have given instructions for the enforcement of that order by the State Motor Vehicle Department and by every other State enforcement agency.

"I feel sure that the citizens of California are ready and willing to comply with this regulation and that the negligible few found violating the same can and will be legally and effectively dealt with."

The Governor's proclamation is as follows:

EXECUTIVE ORDER

IT appearing that pursuant to my executive order of July 31, 1942, relating to the conservation of State-owned passenger automobiles, the committee thereby appointed has under date of September 26, 1942, promulgated certain specific rules and regulations concerning the use of State-owned automobiles and has given notice thereof to all State departments, boards, institutions, teachers' colleges, and special schools by circular letter dated September 26, 1942, and it appearing desirable that same be properly ratified by me,

Now, therefore, it is hereby ordered that the said regulations as set forth in the said letter of September 26, 1942, signed by Frank W. Clark as Director of the Department of Public Works and Chairman of the said committee, be, and the same hereby are, ratified, confirmed and validated. In the event that the said rules and regulations hereby ratified are in any respect inconsistent with my said executive order of July 31, 1942, then to that extent the said executive order of July 31, 1942, is hereby amended.

Dated: Sacramento, California, this 26th day of September, 1942.

CULBERT L. OLSON,
Governor of California

GOVERNOR'S PROCLAMATION

"WHEREAS, By executive order the President of the United States has vested in the Director of Defense Transportation the authority to take all necessary measures to conserve the highway transportation facilities of the Nation, with particular reference to the conservation of rubber; and

"WHEREAS, Pursuant to the authority so vested in him, the Honorable Joseph B. Eastman, Director of Transportation, on September 26, 1942, issued an order designated as General Order, Office of Defense Transportation No. 23, which in part reads as follows:

"Section 501.126 Limitation on Speed. No person shall drive or operate or cause, permit, suffer or allow to be driven or operate any motor vehicle within the continental limits of the United States at a rate of speed which is (1) in excess of the applicable speed limit duly prescribed by competent public authority, or (2) in excess of thirty-five (35) miles per hour, whichever rate of speed is the lesser.

"Section 501.127 Exemption. The provisions of this subpart shall not apply to: (A) any motor vehicles driven or operated by or under the direction of the military or naval forces of the United States, or State military forces organized pursuant to Section 61 of the National Defense Act as amended.

"(B) Any motor vehicle when driven or operated in emergency for the protection or preservation of life, health, or for public safety: providing that this paragraph shall not be so construed as to authorize any such motor vehicle to be driven or operated at a rate of speed in excess of that which is reasonable under conditions prevailing at said time.

"Section 501.129 Effective Date. This subpart shall become effective October 1, 1942, and shall remain in full force and effect until further order of the office of Defense Transportation, except that as to any person operating any motor vehicle for hire in scheduled regular route service, shall become effective on October 15, 1942."

"WHEREAS, Said order is fully justified by the present war emergency existing in the Nation, and particularly in the State of California, a state of emergency having been proclaimed to exist within the State of California by proclamation of the Governor thereof on December 14, 1941; and

"WHEREAS, It is necessary that the speed limit so ordered be observed, and that provision be made for the enforcement thereof in order to conserve public and private transportation in this State;

"Now, therefore, I, Culbert L. Olson, Governor of the State of California, under and by virtue of the authority vested in me as chief executive of the State of California, and in response to the appeal to all State and local governments to make effective the said order of the Director of Defense Transportation, do hereby declare and proclaim that it is necessary to the war effort that the said speed regulations above set forth be strictly observed in the State of California from and after October 1, 1942, except that this order shall not be deemed to increase any existing speed limit within the State of California.

"I further call upon each and every driver of a motor vehicle within the State of California, as his patriotic duty, to observe said speed limit to conserve to the fullest extent the rubber which is so vital to the war effort.

"I hereby direct the Director of Motor Vehicles, acting through the California Highway Patrol and the Division of Drivers' Licenses of the Department of Motor Vehicles, to take all lawful action necessary to enforce said speed limit and to compel observance thereof with all facilities at his command, and request that all local law enforcement agencies likewise take all lawful measures to enforce said speed limit within their respective jurisdictions."

The rules and regulations set up by the Governor's special committee are as follows:

1. Each Department, Board, Commission, Institution, Teachers College and Special School (hereinafter referred to as "State Agency") is to set up immediately a departmental pool of automobiles under its control with such sub-pools as may be necessary.

2. The head of each State Agency shall assign to some employee thereof the responsibility for conservation of its automobiles in compliance with these rules and regulations. Such responsibility shall be in addition to the other duties of such person. The person to whom this responsibility is assigned is referred to in these regulations as "Departmental Coordinator."

There shall likewise be designated for each such agency additional employees as may be found necessary to act under the Departmental Coordinator in respect to any sub-pool of motor vehicles. Such responsibilities shall be in addition to the other duties of such persons. The employees so designated shall be referred to herein as "Sub-Coordinators."

3. No State automobile shall be used for other than essential use. Essential use is broadly defined as that necessary in furthering the war effort or for enforcement of State laws relating to the public health and safety or for the performance of a vital public service.

All State passenger automobiles not required for essential uses shall be put in pool storage by the agency responsible therefor and facts pertaining thereto reported to the Coordinator in detail.

4. The Coordinator shall have authority:

a). To require of each State Agency such reports as he may deem necessary relating to State-owned automobiles under its control and to the uses thereof.

b). To order any State Agency to discontinue any use which he determines is not an essential use.

c). To order any State Agency to surrender possession, transfer possession, or do any other act in respect to possession, use, or control of any State automobile provided that no vehicle used in the performance of essential functions relating to the war effort shall be so transferred, loaned, or used as to jeopardize any State Agency's priority for tires or for recapping of tires.

d). It shall be the duty of each State Agency and the head thereof to comply promptly with any order or direction of the Coordinator. Any State Agency aggrieved by any decision of the Coordinator may appeal the same to the Committee. Pending the determination of such appeal, the aggrieved State Agency shall comply with such decision and order.

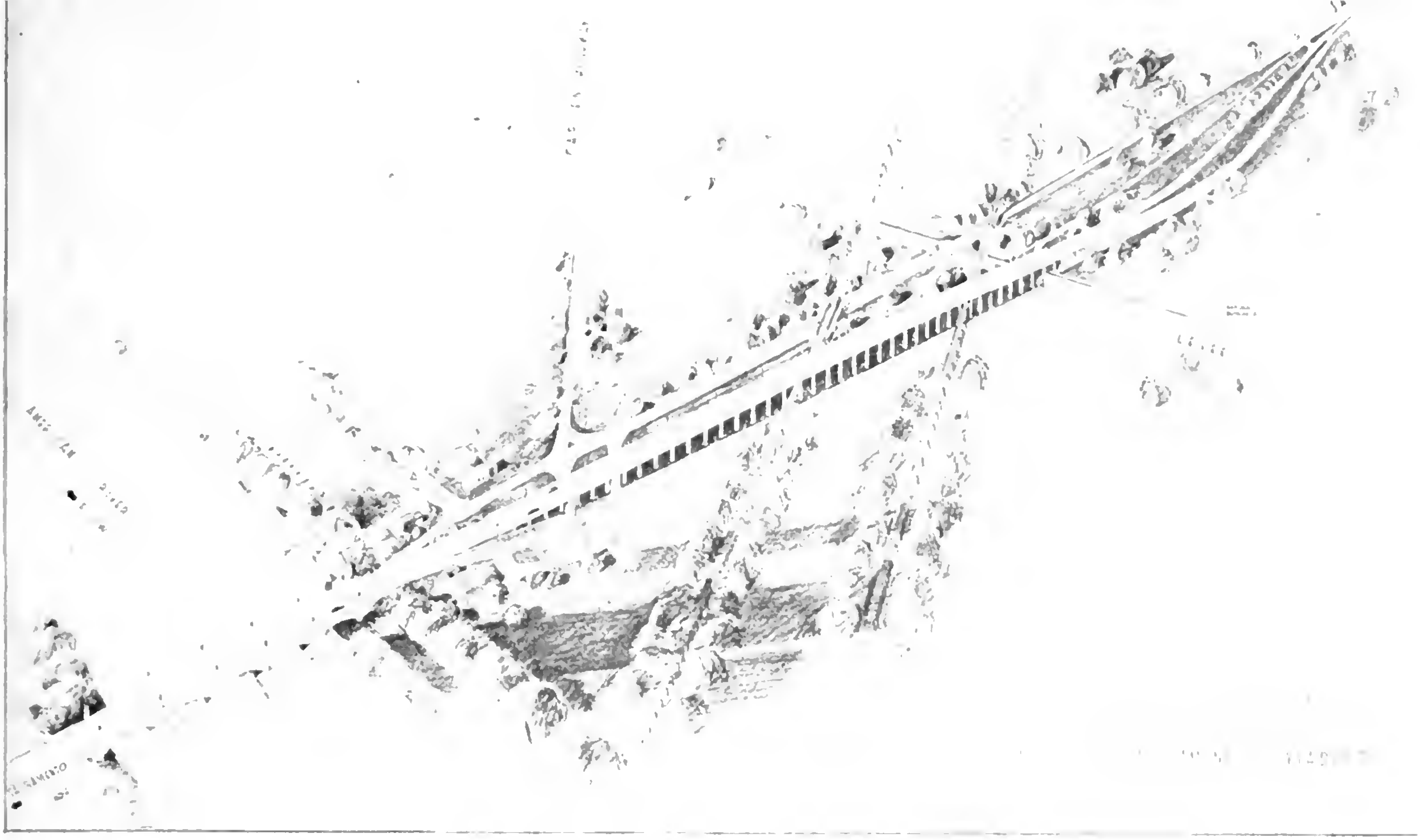
5. State-owned passenger automobiles are to be used only when other forms of transportation are not available for accomplishment of the purposes of the trip, and in no event for other than essential use. No State-owned passenger automobile shall be taken from a pool or sub-pool for use without the prior written approval of the Departmental Coordinator or Sub-Coordinator. Such approval shall be made on a written requisition of such transportation, which must in each case be signed by an authorized officer and filed with the Departmental Coordinator or Sub-Coordinator. The requisition must show the name or names of the employee or employees to use the automobile, the necessity for such use, and the period of the contemplated use.

6. Each State Agency shall maintain a list of such State-owned automobiles under its control which are assigned to individuals on a permanent basis instead of being maintained in a pool or sub-pool. Each such case shall be reported by the State Agency to the Coordinator with a statement of the necessity for such permanent assignment. An assignment of a vehicle from the pool or sub-pool to one individual for more than thirty days shall be considered a permanent assignment.

7. Wherever feasible State-owned automobiles will be garaged in State-controlled facilities. The use of State automobiles as a means of transportation between home and office is prohibited except where necessarily required by the nature of the work as in the case of a police officer subject to call. Where storage is regularly permitted at the home of an employee, that fact shall be reported in writing to the Coordinator with a statement of the necessity therefor.

8. No State car shall be operated at a speed in excess of 35 miles per hour except in actual use in police work and except in cases of extraordinary emergency involving great danger to life and property.

9. The foregoing rules and regulations are to be put into effect in each department with all possible expedition. Each State Agency will be required to furnish all information herein contemplated covering the use of any automobile under its control on and after October 1, 1942.



Artist's sketch of viaduct over American River overflow area on U. S. 99 between Sacramento and North Sacramento

North Sacramento Viaduct, Over Flood Area, Officially Opened to Traffic

OLD timers who remembered the days when a wooden trestle for horse-drawn traffic connected Sacramento and what is now the thriving city of North Sacramento got a real thrill when the $631,000 North Sacramento viaduct was officially dedicated on September 14th.

It was back in the 90's when the supervisors of Sacramento County constructed a timber viaduct crossing the American River bottom lands between Sacramento and North Sacramento, then a part of the famous Haggin Grant. Today, traffic crosses this stretch over a modern bridge structure which passes over the tracks of both the Northern Electric and Western Pacific railroads, which in those early days had not entered the capital city.

The new all-weather, all-year highway link solves a problem with which the Division of Highways has had to contend each winter when overflow waters from the American River necessitated closing of this important route for days at a time, compelling traffic to detour over Jibboom Street.

State, county, and city officials, together with representatives of the chambers of commerce of Sacramento and North Sacramento and other civic organizations, participated in the celebration.

Representing Governor Culbert L. Olson and Director of Public Works Frank W. Clark, Deputy State Director of Public Works Morgan Keaton signalized opening of the viaduct by cutting a red ribbon stretched across the span.

"During the present emergency," Keaton said, "it has been and is essential to eliminate red tape in every conceivable way. The rapid completion of this structure is indicative of the speed and efficiency with which we are operating in war time. All unnecessary red tape has been cut. It is therefore appropriate that the final gesture in dedicating this viaduct should be the cutting, not of a silk ribbon, but of a red tape.

"For some time we realized that the three-lane highway under the two railroads was inadequate, but funds also were inadequate. However, during the last biennium, Governor Olson wrote a letter to Director of Public Works Clark at the request of the Secretary of War, urging that the

(Continued on page 16)

At top—Full width view of completed roadway of North Sacramento viaduct showing four-lane divided highway with raised curbed median strip, four feet wide. Each traffic lane is 25 feet wide. Bottom—View of east bound traffic using structure immediately after dedication. (See story on pages 3 and 16.)

Debris Control at Culvert Entrances On California State Highway System

By GEORGE A. TILTON, Jr., Assistant Construction Engineer and CLARENCE F. WOODIN, Assistant Maintenance Engineer

As announced in the August, 1942, issue of this magazine, the following article is the second of a series of technical abstracts from a joint departmental review of culvert practice of the California Division of Highways by a Committee composed of R. Robinson Rowe, Assistant Engineer, Bridge Department; and Robert L. Thomas, Assistant Engineer, Surveys and Plans and the writers. Following the opening article on comparative hydrology in the September issue, this article defines and classifies debris and control measures, recommending that greater attention be given this problem at time of preliminary surveys of culvert locations.

CONGESTION of drift, debris, and detritus at culvert entrances with resultant impairment of culvert efficiency proved to be one of the outstanding observations of the committee's field studies.

During ordinary years, the occasional interruption of stream flow at culvert entrances by concentrated debris was not particularly alarming, but when congestion of debris caused extensive roadbed washouts in the 1938-40 series of exceptional storms in California it became evident that consideration should be given to designing culverts to pass the debris or that the debris must be controlled to avoid the congestion.

Such conditions were aggravated by changes in culture of tributary basins, as by burning, logging, clearing, cultivation, or building; also by the accumulation of debris in remote channels, ready to move with the first big flood.

FIELD OBSERVATIONS

As pointed out in the introduction to this series of articles,* it was not until 26 to 28 years after the inauguration of the State Highway System in California that widespread storms of extreme intensity occurred to focus attention on the importance of controlling debris. At the time of the 1915-16 floods, development of the State Highway System was in its infancy, and comparatively few culverts had been installed.

The first step in approaching a solution of the problem was the study of existing debris control measures as found at scattered locations throughout the State. Significant was the fact that practically all types wherever encountered were found to be generally effective regardless of type and suitability. These observations led to the idea of classifying the various types of debris barriers and their adaptability to various conditions as found in the field.

STREAM BURDEN CLASSIFICATIONS:

1. Very light floating debris or no debris.
2. Light floating debris—
   Small limbs or sticks, orchard prunings, tules, and refuse.
3. Medium floating debris—
   Limbs or large sticks.
4. Heavy floating debris—
   Logs and trees.
5. Flowing debris—
   Heterogeneous fluid mass of clay, silt, sand, gravel, rock, refuse, or sticks.
6. Fine detritus—
   Fairly uniform bed-load of silt, sand, gravel, or granitic materials more or less devoid of debris, tending to deposit upon diminution of velocity.
7. Coarse detritus—
   Coarse gravel or rock fragments.
8. Boulders—
   Large boulders and large rock fragments carried as a bed-load at flood stage.

DEBRIS BARRIER CLASSIFICATIONS:

a. Debris deflector—
   A "V" shaped barrier placed at the entrance of a culvert pointed upstream, which tends to deflect heavy floating debris or boulders away from the culvert entrance during high-velocity flow.

b. Debris rack—
   A straight barrier placed across the stream channel which tends to separate light and medium floating debris from stream flow and prevent it from reaching the culvert entrance.

c. Debris crib—
   Open crib type of barrier placed vertically over the culvert entrance which tends to prevent a surge of coarse detritus and floating drift from entering and blocking the culvert entrance.

d. Debris riser—
   Closed type of barrier placed vertically over the culvert entrance which causes deposition of flowing debris and fine detritus before it reaches the culvert entrance.

e. Debris basin—
   A natural basin formed by construction of an embankment across a steep well-defined draw which is capable of retaining and storing detritus.

f. Debris spillway—
   A large opening in a roadway dyke for the purpose of spilling accumulated storm water from the roadbed.

RECOMMENDATIONS OF COMMITTEE

The following recommendations of the committee are intended as a guide for the purpose of selecting and adapting debris control measures in accordance with some preconceived basic principles.

The successful use of various experimental types installed within the last three years is encouraging, and it is hoped that new types and adaptations will be developed by further experience with the different various types and conditions.

* August, 1942 California Highways and Public Works

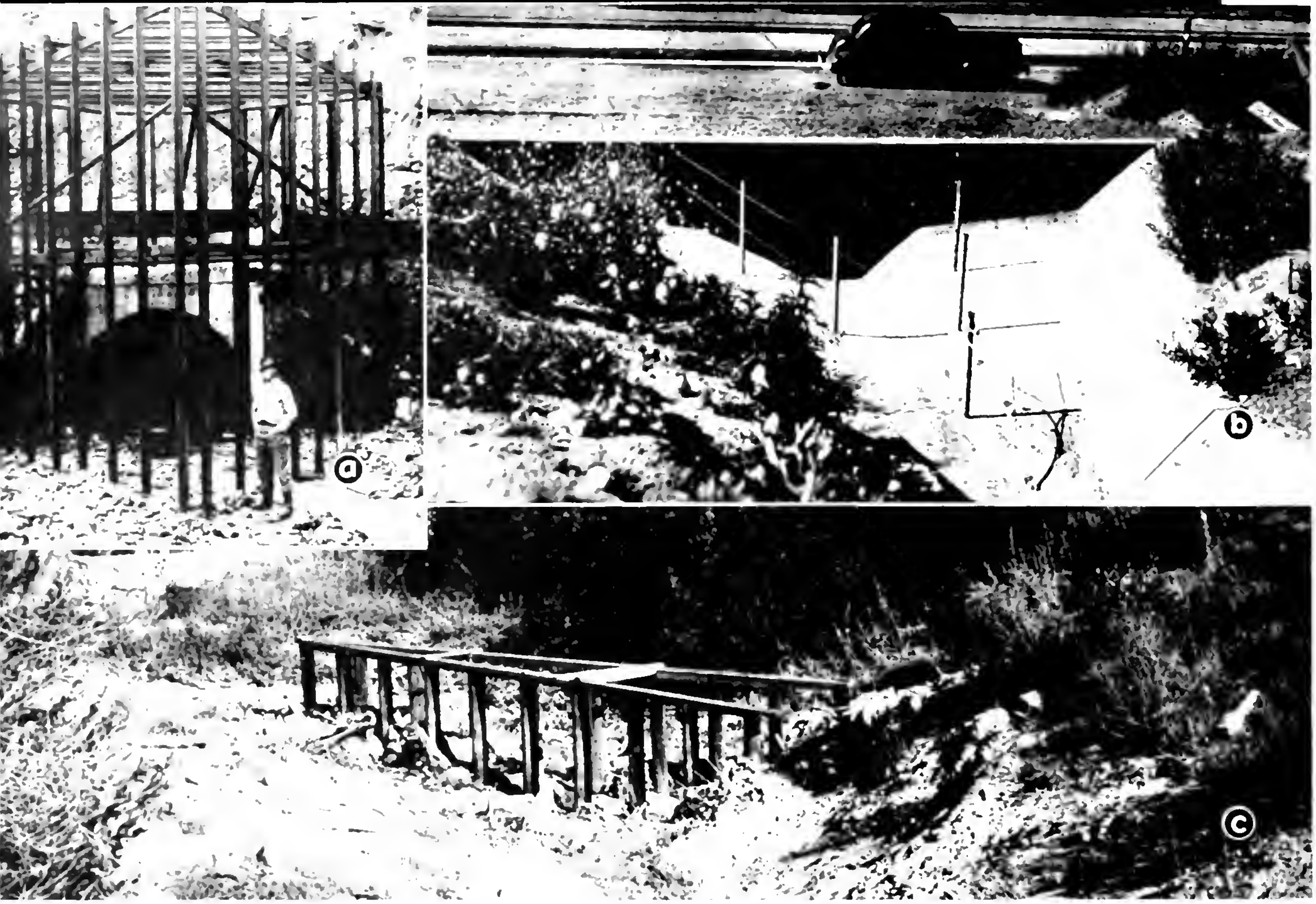


FIGURE 6. (a) Steel rail debris deflector placed at entrance to a large concrete arch culvert. (b) Wire and pipe debris deflector installed at entrance to R.C.P. culvert to deflect light floating debris. Note drop-down approach to culvert entrance. (c) Wooden pile debris deflector installed at entrance to a large culvert for the purpose of deflecting bed-load of large boulders and heavy floating debris

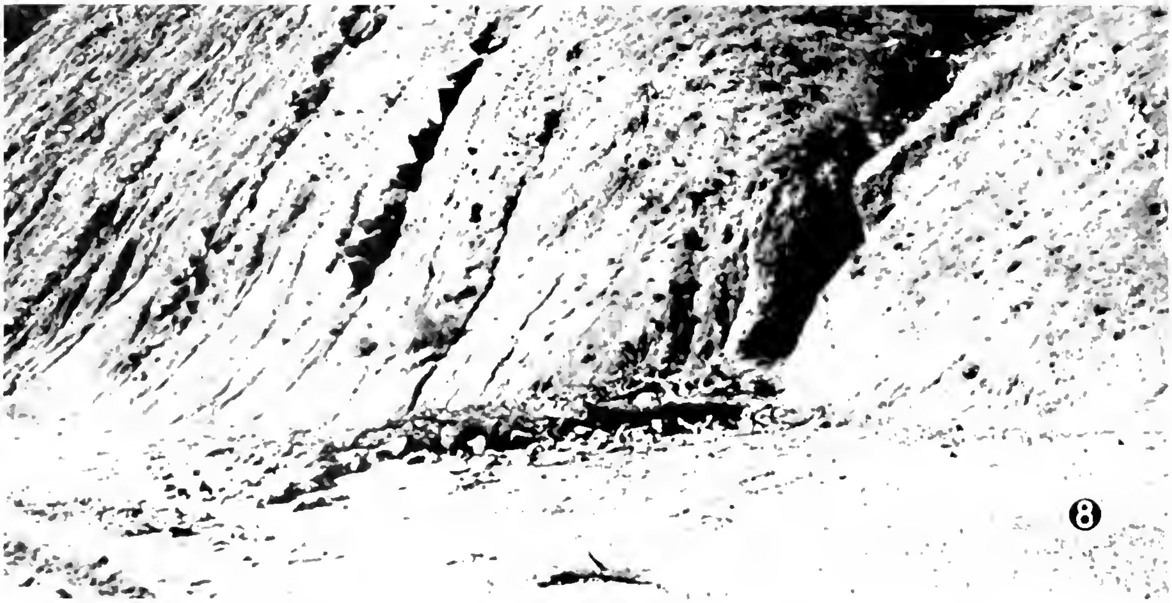


FIGURE 7. Metal debris riser placed over culvert entrance in debris basin. Note provision for extension when debris basin has filled to such an extent as to cause deposition of most of the detritus before it reaches the riser

FIGURE 8. Typical small culvert failure caused by deposition of detritus and light floating debris at culvert entrance due to abrupt grade break at roadway gutter

Debris Deflector

The debris deflector is adapted to diversion or deflection of heavy floating debris and large boulders or rocks carried as a bed load in moderate to high-velocity flows often encountered in mountainous terrain (See Figure 6-e).

This type is particularly useful at the entrance to large culverts and should be of heavy construction with the vertex of the "V" placed upstream. The vertex may be vertical or inclined. Horizontal spacing of vertical members of the deflector should not exceed the horizontal diameter of the culvert. Length of the "V" generally should be not less than three to four times the horizontal diameter of the culvert.

Like all other types of debris separating devices, the debris reflector requires periodic or seasonal removal of accumulated material.

Debris Rack

The debris rack in its various forms is essentially a straight rack placed across the path of a defined channel for the purpose of sieving floating debris from the stream flow and preventing it from reaching the culvert entrance at times of momentary flood peaks. The rack may be vertical or inclined. If inclined, it may serve some of the purposes of a deflector (Figure 9).

Experience with the debris rack indicates that a spacing of vertical bars equal to one-half the horizontal diameter of the culvert is satisfactory. This spacing of vertical bars permits light debris to pass the rack endwise, which will also pass the culvert.

If the channel is well-defined, the debris rack should be placed well upstream from the culvert entrance. If limited by right of way or channel shape, it may be installed at the head of wings, in which case the rack should be as high as the culvert parapet.

Debris Crib

The debris crib, commonly called a "bear trap," has been successfully developed for locations where abrupt grade breaks cause deposition of detritus and clogging of the culvert

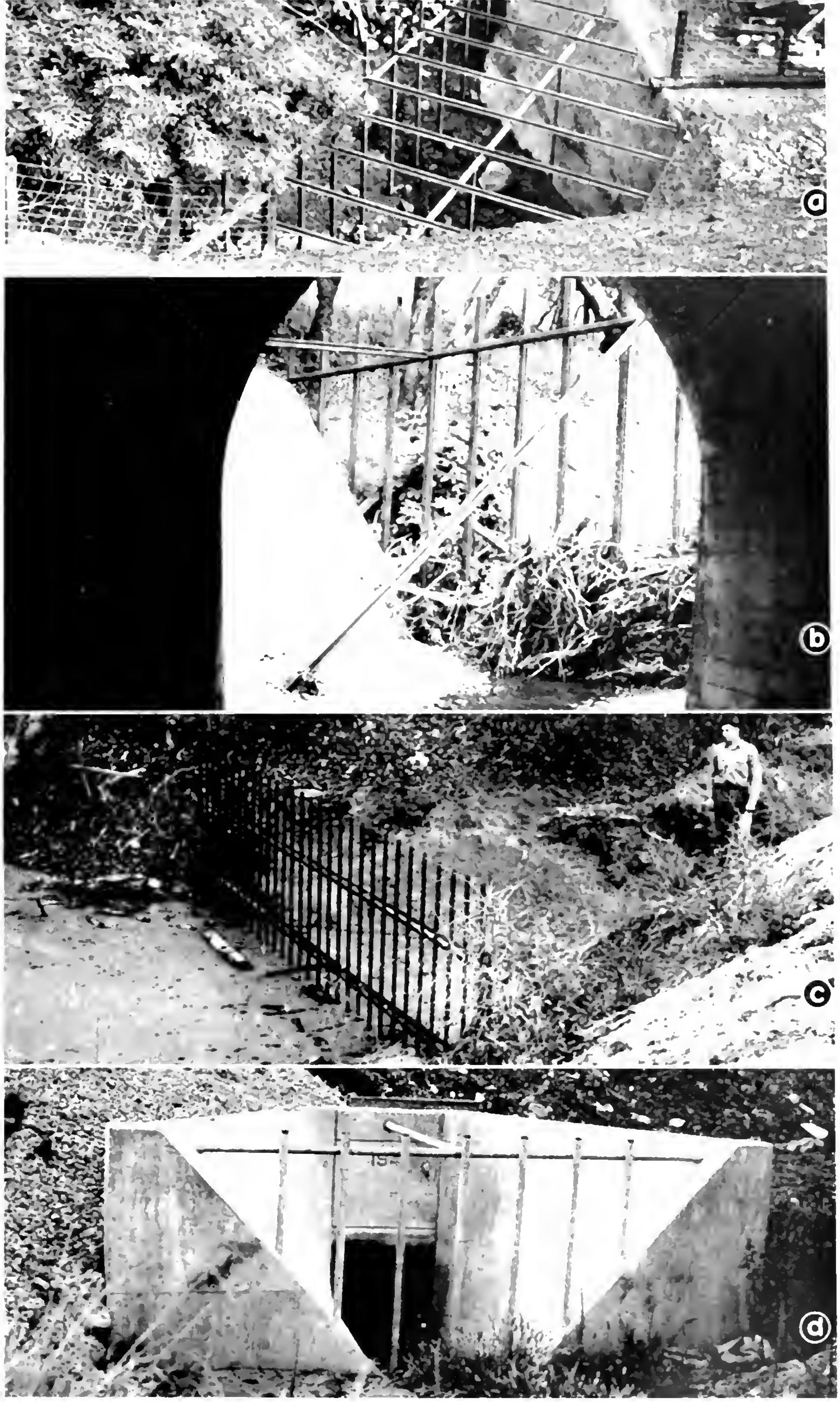


FIGURE 9. (a) Steel rail debris rack installed at end of wing walls to large reinforced concrete arch culvert. (b) Steel rail debris rack at end of wing walls to reinforced concrete arch culvert. (c) Steel rail debris rack placed in channel well above a culvert entrance. (d) Pipe debris rack at end of wing walls to reinforced concrete culvert. Note warped wing walls and curved-lip entrance

FIGURE 11. Top—Debris spillway entrance on rock slope in foreground. Bottom—Lined debris spillway entrance. Upper right—Typical debris basin spillway in mountainous terrain, lined spillway in background and unlined spillway in foreground

entrance. For many small culverts at or near the roadbed level, the abrupt break in grade can not be avoided. Figure No. 8 depicts a typical case so troublesome to the maintenance foreman.

The open type of debris crib is built of either timber, metal, or concrete with or without a cover and is placed directly over the culvert entrance. So placed, with a cover, detritus or debris can practically envelop the crib without completely shutting off the entry of water into the culvert. (See Figure No. 10b)

Where the open crib type is used as a riser in anticipation of a considerable depth of detritus, as in a debris basin, it should be built well above the estimated height of deposit on the culvert entrance, with provision for further increase in height as required. (See Figure No. 10a)

Debris Riser

In mountainous terrain involving high embankments, a common drainage practice requires the location of a culvert in the bottom of a waterway which places the culvert entrance in the lowest part of a debris basin susceptible to rapid filling with flowing detritus.

At such locations it is essential that the muck be kept from entering and clogging the culvert entrance. A successful solution to this problem requires a vertical riser of perforated construction either of pipe, timber, or concrete, placed directly over the culvert entrance. Perforations or openings in the riser should be large enough to permit entry of water and small enough to exclude entry of muck. The barrel or chimney should be carried well above any anticipated deposit and increased in height as necessary. (Fig. 7)

Debris Basin

In certain mountainous areas of easily eroded materials, particularly granitic materials, with steep slopes and heavy run-off, it has been found to be economically impractical to provide a culvert large enough to safely carry surges of flowing detritus.

The perforated debris riser as an expedient solution prevents clogging of the culvert entrance at a critical period when the debris basin is filling with a surging heterogeneous mass of muck, rock, and debris from surface accumulations. The basin simply acts as a reservoir to store the flowing [illegible] by year [illegible] at a safe distance [illegible] entrance.

Debris Spillway

The most serious losses of embankments were found in the heavily forested mountainous areas throughout the State where debris basins proved inadequate, resulting in water overflowing the roadway and in some cases causing complete washouts.

The investment in heavy embankments across the ravines encountered in rough terrain definitely warrants not only ample principal drainage, but the development of auxiliary drainage facilities as a factor of safety.

The debris spillway, as an adjunct to the debris basin, is considered by the committee to be one of the foremost improvements in California drainage practice developed subsequent to the 1933-1934 floods, notably on the Angeles Crest Highway east of La Canada in Los Angeles County.** See Figure 11.

EXPENSE IS RELATIVELY SMALL

As pointed out in the previous article on comparative hydrology,* the storm of 100-year frequency occurs every year somewhere in California, and when it does occur the damage is usually serious. The expense of providing against heavy damage from even the 100-year frequency storm is relatively small.

The combination debris basin and spillway plan of drainage consists of a debris basin provided with a culvert and riser for normal drainage, supplemented by auxiliary drainage facilities wherein flow of water into the roadbed from an overtaxed debris basin is confined inside the shoulder dykes and flows down the channelized roadbed until a safe and natural place is found to spill the water from the roadway.

* September, 1942, California Highways and Public Works.

** April, 1935, California Highways and Public Works.

Continued on page 17

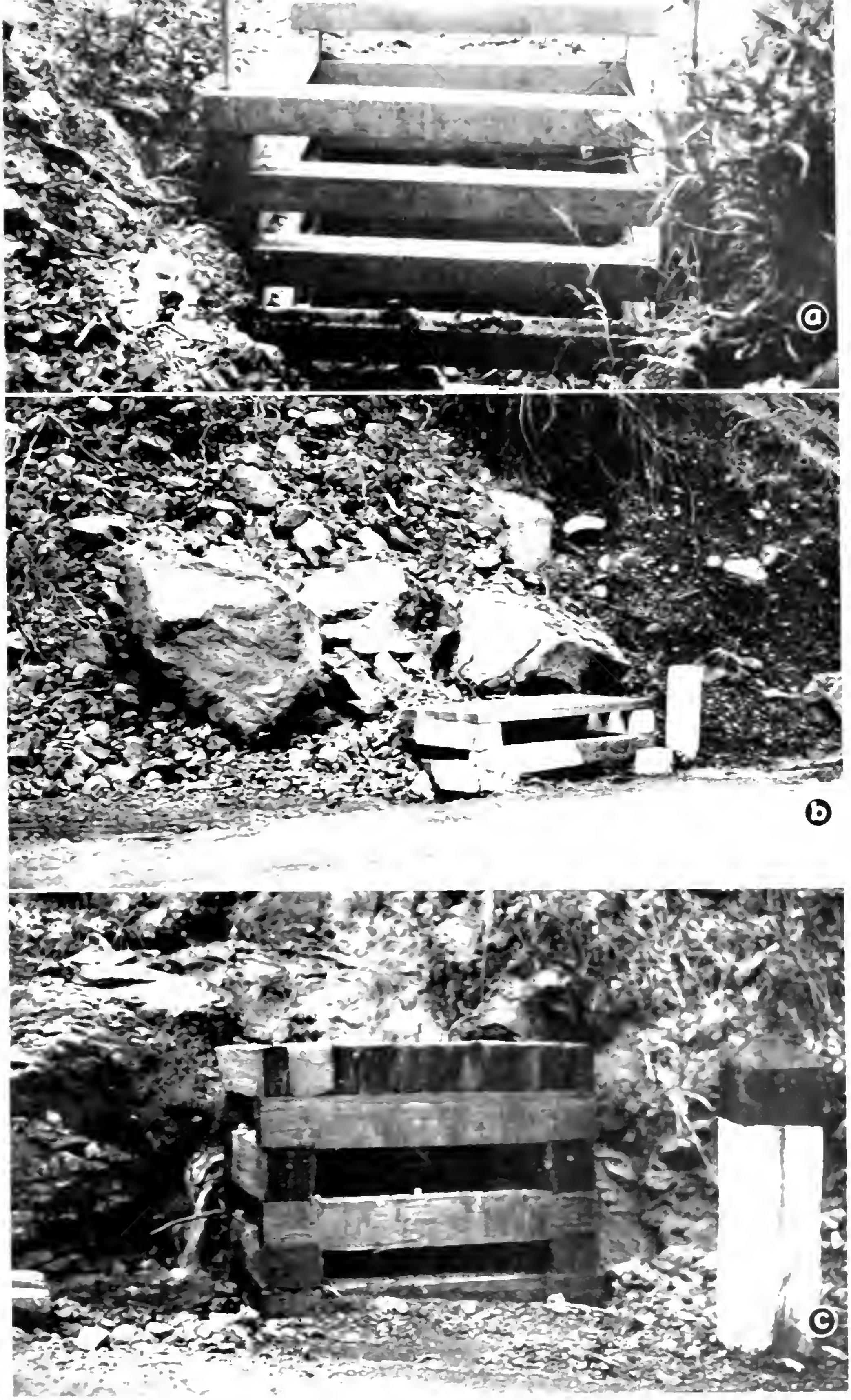


FIGURE 10. (a) Debris crib of reinforced concrete, with provision for extension, placed over culvert entrance in small debris basin and commonly known as a "bear trap." (b) Timber debris crib installed over culvert entrance in roadway gutter. Note how debris has been prevented from blocking culvert entrance. (c) Debris crib of hewn timber, with a solid cover, placed over culvert entrance in roadway gutter.

View of typical section of 4-lane divided highway on partially completed Davis-Dixon cut-off recently opened to traffic

Davis-Dixon Cut-off on U. S. 40 Open; Saves 150,000 Vehicle Hours

By P. O. HARDING, District Engineer

OVERSHADOWED by our present tremendous war effort, on Tuesday, September 22, 1942, without more than passing notice, public traffic was quietly permitted for the first time to travel over one side of the four lane divided highway between one mile north of Dixon and the South Fork of Putah Creek, and on both sides of the divided highway from there on to one mile east of Davis on the Davis-Dixon cut-off.

The Davis-Dixon cut-off has been the subject matter of two previous articles, by District Engineer Pierce, in the March and September, 1940, issues of "California Highways and Public Works." This cut-off, 7.3 miles in length, starting in District III east of Davis and ending north of Dixon in District X, and crossing Putah Creek at the Solano-Yolo county line, the Southern Pacific railroad one-half mile southwest, and the South Fork of Putah Creek two and one-half miles southwest, has involved work under seven contracts.

SEVEN CONTRACTS INVOLVED

Four of these were for structures under the supervision of the Bridge Department, W. J. Deady, Resident Engineer; three were road contracts, one of which was handled by District III, J. W. Corvin, Resident Engineer, and two by District X, George Hubbard and R. H. Lapp, Resident Engineers.

The original contract was handled by District X, awarded to Fredricksen Brothers of Emeryville, and covered the grading of the entire 7.3 miles, excepting therefrom the portions involving major structures. This grade was constructed to four-lane divided width northeast of the South Fork of Putah Creek, and two lanes, or one side of the divided highway grade, southwest of this south fork, which was originally known as the Putah Creek overflow.

One of two one-way bridges on Davis-Dixon cut-off. Each one carries two lanes of traffic across Putah Creek

A second contract was awarded to Heafy-Moore Company and Fredrickson and Watson Construction Company for the construction of a four-lane divided underpass at the Southern Pacific railroad crossing about one-half mile southwest of the Putah Creek crossing. This was a Bridge Department contract.

A third contract under the supervision of District III was awarded to Fredrickson and Westbrook and involved the completion of grading and paving a divided highway with four lanes of concrete from one mile east of Davis to the South Fork of Putah Creek.

TWO BRIDGE CONTRACTS

The fourth and fifth contracts, under the supervision of the Bridge Department, involved the construction of the two bridges required at each stream crossing of Putah Creek and the South Fork of Putah Creek and a number of other overflow points. These contracts were awarded to A. Soda and Sons and E. T. Lesure. A sixth contract, just being completed by N. M. Ball and Sons, under the supervision of District X, involves the completion of grading and paving on the 4.2 mile section lying southwest of the Putah Creek overflow.

Very unfortunate storm damage to two major bridge structures under construction at the South Fork of Putah Creek in the floods of last winter have delayed completion of the northwesterly bridge and the full benefit of this divided highway can not be realized until its completion, which is tentatively set for December of this year. The seventh minor bridge contract was necessary to repair damage to the southeasterly bridge at this same overflow crossing and the completion of this structure, coincident with the paving under the N. M. Ball and Sons road contract has made it possible to use this highway for two lanes of traffic southwest and the full four lane divided highway northeast of this overflow.

The present 4.2-mile paving contract consisted of the grading and placing of imported select base on one side and paving on both sides of the divided highway. The typical section as now constructed consists of an 11-foot outer and a 12-foot inner lane of portland cement concrete 8 inches to 11 inches in thickness on each side of a dividing strip of imported select material generally 32 feet in width.

An armor coat border has been placed 2 feet wide adjacent to the dividing strip and 3 feet wide next to the outer lanes. An additional 3-foot width of dividing strip and 5-foot width on outer edges has received penetration oil treatment to provide generally a 5-foot shoulder in the dividing strip next to the 12-foot concrete lane and an 8-foot shoulder outside adjacent to the 11-foot concrete lanes.

Due to the heavy underlying adobe soil of this area, specifications required a minimum of 15 per cent moisture which was maintained until the concrete pavement was placed.

Although the last of the approximate 25,000 cubic yards of concrete pavement required under this contract was poured on July 17, the contractor has since this date encountered many difficulties in obtaining the necessary materials, equipment and labor to complete the numerous details incidental to a project of this magnitude. These included a comprehensive channelization where the new highway clips a right angled corner of the old route which will continue as an important artery of travel to and from Northern California points.

SAVES 150,000 VEHICLE HOURS

The completion of the northwesterly bridge over the South Fork of Putah Creek will culminate work started on this project some three years before, involving construction expenditures in excess of $1\frac{1}{4}$ million dollars and shortening the travel distance between San Francisco metropolitan bay area points and Sacramento by 3.25 miles, aggregating some 5 million vehicle miles of travel annually.

With present 35-mile-per-hour speed restrictions, the time-saving is accentuated, resulting in an annual saving of some 150,000 vehicle hours. Under present rubber restrictions, on a highway now carrying predominantly heavy truck traffic, this represents a very substantial contribution to the war effort.

Overheard at the meeting of newly-elected officials of a city council: "Let us," said one of the aldermen, "put our heads together and make a concrete road."

Wood to Replace Steel for State Highway Signs

For the duration, there will be no more steel signs directing and warning motorists along the highways and byways of California.

Cooperating with the government's request to conserve critical materials, the markers posted by the sign-posting department of the Division of Highways, through the wartime emergency, will be composed of pressed hardwood.

Reflectorized signs will be made of the same material, beaded to reflect headlights. The first beaded placards were posted recently along the Southern California coastline designating authorized dim-out zones, replacing the emergency heavy cardboard markers.

Pre-war signs were made of porcelain enamel fused into steel for indefinite lasting qualities. The substitute pressed wood signs, treated and painted for preservation, are expected to prove durable for a number of years.

Redwood posts will be utilized where metal posts were previously used. For the few instances where metal standards may be considered absolutely necessary, a small supply of such poles remain in stock. The only metal signs installed will be a few standard types still on hand.

A Horse On The S. I.'s

H. F. Briggs, District Office Engineer of District VI, sends us the following:

"Recently, District VI S.I.'s engaged in setting stakes preparatory to running levels in a pasture on a minor job in Kings County, were startled and then annoyed by seeing a horse following them and methodically pulling up the stakes with his teeth. Clods and other appropriate missiles were necessary to keep Dobbin far enough away to allow the work to be completed. The S.I.'s seem to feel it was a horse on them."

Four-lane divided underpass on Davis-Dixon cut-off where the Southern Pacific Railroad crosses the highway. This structure is one of the modern features which permit a saving of 150,000 vehicle hours annually

State Offers Aid to Golden Gate Bridge in Solving Fiscal Problems

FINANCIAL aid to Golden Gate Bridge and Highway District was given impetus last week by Governor Culbert L. Olson when he asked Director of Public Works Frank W. Clark to render every possible cooperation by the State of California. Likewise the Governor urged President Roosevelt and members of the California congressional delegation to seek every assistance possible from the Federal Government. The following letter was sent by the Governor to the President of the United States:

"Dear Mr. President:

"I have come to the conclusion the financial situation respecting the Golden Gate Bridge across the entrance to San Francisco Bay merits consideration by the Federal Government. This bridge constitutes one of the most vital links in the defense highway system of the Pacific Coast. It is being used, however, by Federal traffic without charge and the greatly increased amount of such traffic due to the war has placed a burden on bridge finances far beyond that which was anticipated at the time of issuance of the Federal permit.

"In an attempt to meet the situation, the directors of the Golden Gate Bridge and Highway District have imposed increased tolls which adversely affect not only regular commuters, but shipyard workers who reside in San Francisco and who cross the bridge daily to and from recently established yards in Marin County. These commuters and workers are helping to bear a burden brought about by increasing toll-free government traffic, while normal, civilian toll-paying traffic is rapidly decreasing. The result is dissatisfaction—an adverse effect upon the war effort.

"The Maritime Commission is establishing a bus service and also is proposing to institute a ferry service. Such buses pass over the bridge without charge under terms of the Federal permit. The District, however, is attempting to collect tolls from individual passengers on such buses. Further legal controversy is expected over this attempt to secure revenue for the bridge.

"This is the immediate effect. In the long view, taxpayers in six California counties face increased taxation to make up deficits that appear certain to occur.

"I propose to recommend that the State of California do everything possible for assistance of the District, but I urge that the Federal Government also assume its share. The Bridge is on the route of a primary Federal aid highway and there is no reason in equity and justice why Federal assistance should not be given. The Secretary of War, I respectfully suggest, should be authorized, by act of Congress, if necessary, to revise conditions of the bridge permit.

"I have instructed Director of Public Works Frank W. Clark to make a comprehensive survey of the entire situation, and I shall take the liberty to write you further concerning it. I hope for your favorable consideration."

Following up the Governor's request, Director Clark went before the Finance Committee of the Board of Supervisors of the City and County of San Francisco and made the following statement:

"First I would like to compliment members of the Board of Supervisors of San Francisco for taking the steps which have resulted in the meeting of their Finance Committee under the chairmanship of Mr. MacPhee for the purpose of holding this meeting and hearing in a matter that means as much as the Golden Gate Bridge situation does to the general public, to the users of this bridge, both passenger and commercial traffic, as well as to all property owners of the six counties, whose property is financially responsible for any deficit or liability which may accrue as a result of the bridge operations.

It is in that same spirit that the present State administration of California, under the leadership of Governor Olson, is not only interested in this general situation but is vitally concerned and is very anxious to be of help in any way where it may serve to aid all who are affected in this important matter. I am sure all present are familiar with steps which have been recently taken by the Governor as a result of this rapidly changing situation from a financial standpoint, and as we are all well aware, these changes being seriously for the worse as far as the toll-paying users of the bridge and the property owners of the six referred to counties are concerned.

I am sure that we only echo the opinion of all public minded citizens when we say that we have full appreciation of the important and fine job that was done by those who, with courage and initiative, brought into existence this magnificent and important structure. It must be admitted that at least for the present, and in fact during this war, this all important highway defense connecting link would not be available for public use or the defense of our country if it had not been for the unusual vision and excellent work on the part of those who, as private citizens and with private capital, worked out the financial program under which this bridge was designed and constructed.

The original bond purchasers who made available the capital with which to do the job certainly played a very important part in the matter. I am sure we all agree that, without the willingness of property owners in the six counties comprising the District to guarantee the financial set up, the bridge in all likelihood would not have been built and would not now be in existence.

However, we are primarily interested in seeing to it that the toll-paying users of this bridge, who must depend upon its facilities, are not unfairly or unnecessarily penalized. Likewise, the State is not unmindful of the position and, if you please, possibly the predicament of the property owners of the six counties. We fully realize that the bond holders have their legal rights in the matter, and securely situated as they are from a financial standpoint, we cannot reasonably expect them to make concessions in a financial way as might be construed as a subsidy for the bridge operations and carrying charges at the expense of this group.

There is still another element or group who are or who have been identified with this picture whom I must refer to, and this I certainly do without any thought of criticism or disrespect, but I make this statement in order that we may be of practicable help in this entire matter. I refer to those who, primarily for business reasons, were identified with this project from a promotional standpoint and who have in one way or another sold their services in connection with this entire matter in a way that has added materially to the cost side of the ledger as far as bridge operations are concerned. Some very substantial adjustments and improvements have already been made in this respect, specifically as illustrated by employment of James Ricketts, its present capable manager.

Appraising the entire situation, if we are to be expected to be of assistance, and in fact I feel sure before any material actual aid can be realized from any public agency, we believe the following steps must be taken: The operation of the bridge from a personnel standpoint must be carried out on the most efficient and economical basis. We believe that the heretofore broadly circulated statement, to the effect that some day this bridge can be expected to be paid off in full and will prove from that date on to be of financial assistance to the property owners of the six counties in the way of reduction of their taxes, is a fallacy and an unsound approach. We do not feel that it is consistent with good public policy for anyone connected with this bridge in any way to expect either Federal or State financial assistance at this time and still attempt to maintain a position which will make this bridge other than a free bridge for general public use, as soon as its bond obligations are liquidated in full.

The present District property owners, I am sure, will willingly forego any rights they have, or might hope for, in this respect, in the interest of protecting themselves against deficit and liability assessments with which they are practically confronted at the present time. Everybody connected with this bridge must immediately revamp their thoughts and views.

The bond holders who hold the key to this entire matter can only be expected to be of aid provided some arrangement is worked out under which their interests will be fully protected and the benefits accruing to them will not be lessened. This can be accomplished, in my opinion, by a substitution of longer term bonds, provided that other important factor which enters into the value of these bonds can be met by having the new issue of bonds issued tax free—as is recognized to be the case with the bonds now outstanding. This, in my opinion, can be accomplished if quick action is taken.

As might be appreciated I have been watching the operation of this bridge since I have occupied my present position commencing in 1939. During that time there have been many discussions regarding the matter. Various suggestions and proposals have been outlined. The most concrete in this respect emanated from a man who occupied the dual position of a Director of the Bridge District and likewise a very large property owner in San Francisco, as well as at the same time being a man of well known civic interest. I refer to Mr. Arnold Haas, now deceased. Mr. Haas, possibly together with his other associate directors, had evidently given this matter a great deal of intelligent and very constructive thought. It seemed to me that he had a thorough appreciation of the seriousness of the situation which was rapidly becoming more critical at the time of his death, and therefore realized that something must be done. As is typical of most successful business men, Mr. Haas concerned himself with the workout of a program which would be fair to all concerned and therefore probably acceptable and at the same time would accomplish its purpose. In private conversation I told Mr. Haas as I have told other members of your Board of your officers, that before the State would be willing or able to enter into the picture, those certain corrective steps that I have outlined herein would have to be taken. The suggested refinancing plan as outlined by Mr. Haas would reduce the average debt service by $400,000 a year for a thirty-year period. As you well know the present State administration has been committed to a policy of low tolls on public bridges as is well evidenced in the slashing of the San Francisco-Oakland Bay Bridge far from an average of sixty odd cents to 25 cents through successive reductions and by reason of the acquisition of the Carquinez and Antioch bridges through purchase by the State, the tolls on these bridges had even been cut to a greater extent by comparison under State operation at our insistence. Financing for the Carquinez and Antioch bridges was arranged on a basis that even with the present 25¢ toll (probably to be further reduced to 20¢) will result in these two bridges being toll free in 1948. The San Francisco-Oakland Bay Bridge can likewise be hoped to be reduced to 20¢ toll if rubber shortage and gasoline rationing does not too drastically further curtail bridge traffic as compared with the normal expectancy.

The Golden Gate Bridge, on the other hand, has a base toll of more than double that of our State-owned and operated bridges. Its bond requirements under the present arrangement mounts rapidly from $1,711,000 to $3,407,000 and I feel it my duty to say that with the further reduction of tolls on the Carquinez Bridge, plus the fact that it will soon become a toll free bridge, is certain to further divert a great deal of Sacramento Valley traffic of the future. In this connection I want to say that your present rate of tolls, in my opinion, will prove to have brought your financial rate picture up to a point where that if it is not already the case, any further increase will mean having passed the point of diminishing returns.

I pointed out to Mr. Haas and he seemed to fully realize that, as the war progressed, we could expect certain Federal regulation of traffic for conservation of automotive transportation which would adversely affect the normal increase in traffic. However, I was unable to foresee at that time the present acute development in the way of an abrupt cutting down of automobile traffic by reason of the rubber shortage.

All of us should consider the developments in other sections of the country, regarding toll bridges, as an indication of what to expect in the way of future projected trend affecting the Golden Gate Bridge.

New York's Triborough Bridge Authority in August, according to reports, showed a decline in revenue of over 46% from the corresponding month of 1941. The Pennsylvania Turnpike showed an overall loss of slightly more than 50% in revenue, but passenger car revenue was off 75%.

(Continued on next page, column 2)

W. H. Holmes Appointed Engineer In Charge of Design and Safety of Dams

W. H. HOLMES, Senior Engineer of Hydraulic Structure Design in the State Division of Water Resources, has been appointed Supervising Engineer in Charge of Design and Safety of Dams, effective September 1st by State Engineer Edward Hyatt. He succeeds the late George W. Hawley, Deputy State Engineer.

In his new position Mr. Holmes will have charge of supervision of the 640 dams in California under State jurisdiction. These comprise 426 earthfill dams, 40 rockfill, 46 concrete gravity, 6 masonry, 56 single arch, 15 multiple arch and 51 dams of composite or miscellaneous types. Twelve are owned by the State, 186 by municipalities and districts, 128 by power companies and 314 by individual owners. They represent a construction cost of approximately $170,000,000.

Mr. Holmes' headquarters have been in Los Angeles where he has been in charge of dams in the southern part of the State for the past 12 years. He will now be stationed in the Sacramento office of the Division of Water Resources. He joined the Division in September, 1928, and spent the following two years in Sacramento working on engineering studies which followed the disastrous failure of the St. Francis Dam.

Mr. Holmes was born near San Jose, California. During World War I he served overseas with the 23rd Engineers—a highway regiment. Returning to California at the end of the war he completed his education at Stanford University and received his engineering degree in 1921.

After graduating he went to work on design and construction of Stanford Stadium, later working on the preliminary design of the California Memorial Stadium at Berkeley. In 1922 he worked for the Turlock and Modesto Irrigation Districts as transit man. During the following six years he rose to the position of Chief Engineer in the Modesto Irrigation District.

Mr. Holmes is married and has one son who is now attending the California Institute of Technology.

W. H. HOLMES

State Offers Aid to Golden Gate Bridge in Solving Fiscal Problems

(Continued from preceding page)

Surely, no one connected with this matter can fail to recognize that a very critical situation exists. Your present State administration stands ready and is anxious to aid in every possible way. The Governor has directed me to make a financial survey of this entire matter which is already under way. A letter has been directed to the President by Governor Olson, as well as to all California Congressmen and our two Senators in Washington, asking that Federal funds be appropriated to immediately relieve this acute situation. There are three or four approaches that can be made to this matter, where State financial assistance could be brought into the picture (one being State operation), and with the full cooperation of all concerned I am confident that this matter can be worked out in a way that will make it an unfair burden to no one and a benefit to all."

Debris Control at Culvert Entrances on State Highways

(Continued from page 9)

Debris basins spillways should be lined so as to be capable of resisting erosion. In many cases on grades, these spillways may be several hundred feet from the debris basin originating the flow.

Dykes and spillways, to be successful, must necessarily be constructed on an adequately large scale plan.

Committee Conclusions and Recommendations

1. That culvert sites be classified for debris characteristics at the time of the preliminary survey as outlined in "classification of culvert sites" to be described in a later article.

2. That debris control measures be considered as an essential part of culvert design, to be developed before or during design of conduit—not afterwards.

3. That debris barrier types be selected and adapted in accord with the general principles outlined herein.

4. That debris control devices be cleaned of debris and regularly maintained along with other drainage appurtenances.

20 Large Cities Receive All Milk By Motor Truck

Twenty large cities receive all their milk by truck, and many other cities receive a substantial part of their milk by highway transportation, according to the Automobile Manufacturers Association.

The 20 cities depending entirely on the highways for their milk supplies are: Akron, Atlanta, Cincinnati, Dayton, Detroit, Grand Rapids, Hartford, Kansas City, Louisville, Los Angeles, Minneapolis, Oakland, Omaha, St. Louis, St. Paul, Sacramento, San Diego, Spokane, Toledo, and Washington.

Baltimore, Milwaukee, Pittsburgh, and San Francisco receive more than 96 per cent of their milk by truck.

North Sacramento Viaduct Structure Officially Opened to Traffic

(Continued from page 3)

Highway Commission appropriate money for this project, and the contracting for this viaduct was the first piece of highway construction under the present biennial highway budget. The budget went into effect on July 1, 1911, and work began a few days thereafter."

TWO LANES OPENED

President L. J. Brundige, of the Sacramento Chamber of Commerce, presided over the dedicatory ceremonies. He said that the opening of the viaduct climaxed many years of effort on the part of Sacramento and North Sacramento to provide an all-year highway between the two cities. Mayor Tom B. Monk of Sacramento complimented the State Highway Commission for the part it had played in making the project possible. In the absence of Mayor Kenneth Hammaker of North Sacramento, Elwood M. Miller voiced the gratitude of his city.

At the completion of the ceremony, eastbound traffic was directed over two lanes of the structure. Temporarily until completion of the other two lanes, west bound traffic will use the existing low-level three-lane highway.

The project was financed with both State and Federal Aid funds. The cost of construction totals about $563,000 with an additional outlay of $68,000 for rights of way, making a total cost to the State of $631,000.

The viaduct, built on a revised alignment planned to tie in with future development of the route, consists of a reinforced concrete structure 1,496 feet long, consisting of 36 spans of 41 feet and two 10-foot cantilever spans at each end. The roadway is of the four-lane divided type, each traffic way being 25 feet wide and the median strip four feet wide. Two four-foot sidewalks are provided on each side of the bridge. The structure is a two-post bent design supported on pile foundations.

AMPLE RAILROAD CLEARANCE

The clearance over the tracks of the railroads with sufficient allowance for future raising of the grade lines of the railroad trestles, is such that the maximum height of the vertical curve of the structure is 50 feet above the ground.

Approaches to the viaduct are earth embankments and the new four-lane approaches will be surfaced with plant-mixed surface and Portland cement concrete.

In constructing the viaduct it was anticipated that work would be completed early in 1942. However, even with the A-1-e priority which was assigned to the project by the War Production Board, delays in obtaining reinforcing steel have been almost continual since early construction. The result of these delays prolonged the job by many months. Only the persistent efforts of Director Clark, C. H. Purcell, the State Highway Engineer, and Earl W. Heple, the contractor, made possible the obtaining of the necessary steel bars for reinforcement.

The problem of flood waters and a traffic volume of 25,000 cars daily has been finally solved at this point and no longer will the detour over Jibboom Street be necessary.

Among officials participating in the celebration were:

William Rutherford, president of North Sacramento Chamber of Commerce; Arnold Vogel, Chairman of the Highway Committee of the Sacramento Chamber of Commerce; Luther Jones of the Earl W. Heple Company, contracting firm which built the structure; F. W. Panhorst, Bridge Engineer, Department of Public Works; George T. McCoy, Associate State Highway Engineer; Assemblyman John Cain, Assemblyman Earl D. Desmond and Assemblyman-elect Chester Gannon.

In Memoriam

Francis R. Baker

Francis R. Baker of the District IX engineering staff passed away suddenly, at his home in West Bishop, as a result of pneumonia. He was a native of Freeland, New York, where he was born November 29, 1882.

Mr. Baker was among the first engineers employed by the California Highway Commission, having been appointed in District III on February 15, 1912. He remained in that district until June 30, 1927, working as a draftsman, assistant resident engineer, and resident engineer. On July 1, 1927, he transferred to District VIII, but shortly after returned to District III.

Between March 26, 1928, and April 8, 1934, he worked as a resident engineer in Districts IV, II, V, III, VIII, and XI. On April 9, 1934, he transferred to District IX and remained there until the date of his death.

Mr. Baker was highly esteemed by his friends and fellow workers and by those of the community who knew him. He was a member of Palo Alto Lodge of Masons and of Pomona Commandery of Knights Templar. He also was a companion of Owens Valley Chapter of Royal Arch Masons where he was serving as an officer.

His wife, Mrs. Eva M. Baker, and a sister residing in the State of Washington, survive him.

Highway Bids and Awards for September 1942

ALAMEDA COUNTY—Between San Francisco-Oakland Bay Bridge and Toll Plaza, about 0.8 mile to be paved with Portland cement concrete and asphalt concrete. District IV, Route 5, Oakland. Chas. L. Harney, San Francisco, $172,949. Contract awarded to Lee J. Immel, Berkeley, $154,883.

KERN COUNTY—Between Snow Road and 2½ miles south of Shafter Road, about 4.9 miles to be graded and paved with Portland cement concrete. District VI, Route 4, Section D. Griffith Co., Los Angeles, $358,615. Contract awarded to Union Paving Co., San Francisco, $336,340.

MENDOCINO COUNTY—A timber, steel and concrete bridge at Albion across Albion River, having an aggregate length of 969 feet to be constructed. District I, Route 56, Section D. Trewhitt, Shields and Fisher, Fresno, $390,805; E. E. Smith, El Cerrito, $391,430. Contract awarded to Fred J. Maurer & Son, Eureka, $345,528.

MERCED COUNTY—Constructing a bridge across Livingston Canal, 2.5 miles north of Atwater, District X. C. C. Gildersleeve, Colusa, $9,628; Barney B. Goetz, Stockton, $8,365. Contract awarded to M. A. Jenkins, Sacramento, $7,672.

NAPA COUNTY—At Rindler Creek, about 0.5 mile to be graded and surfaced with Portland cement and asphalt concrete and a timber bridge to be removed. District X, Route 7, Section A. Chas. L. Harney, San Francisco, $184,105. Contract awarded to Louis Biasotti & Son, Stockton, $134,742.

California highway border quarantine stations reported 146,274 tourists entered the State during February of this year. More than half of these were tourists from other states, while the remainder were Californians returning home.

"Nobody has a good word for the grasshopper," remarked a Canadian paper, "and yet he was away ahead of everybody in this idea of keeping the farmers from producing too much."

State of California

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Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

FRANK W. CLARK, Director of Public Works

ROBERT H. ROOT, Assistant Director

MORGAN KEATON, Deputy Director

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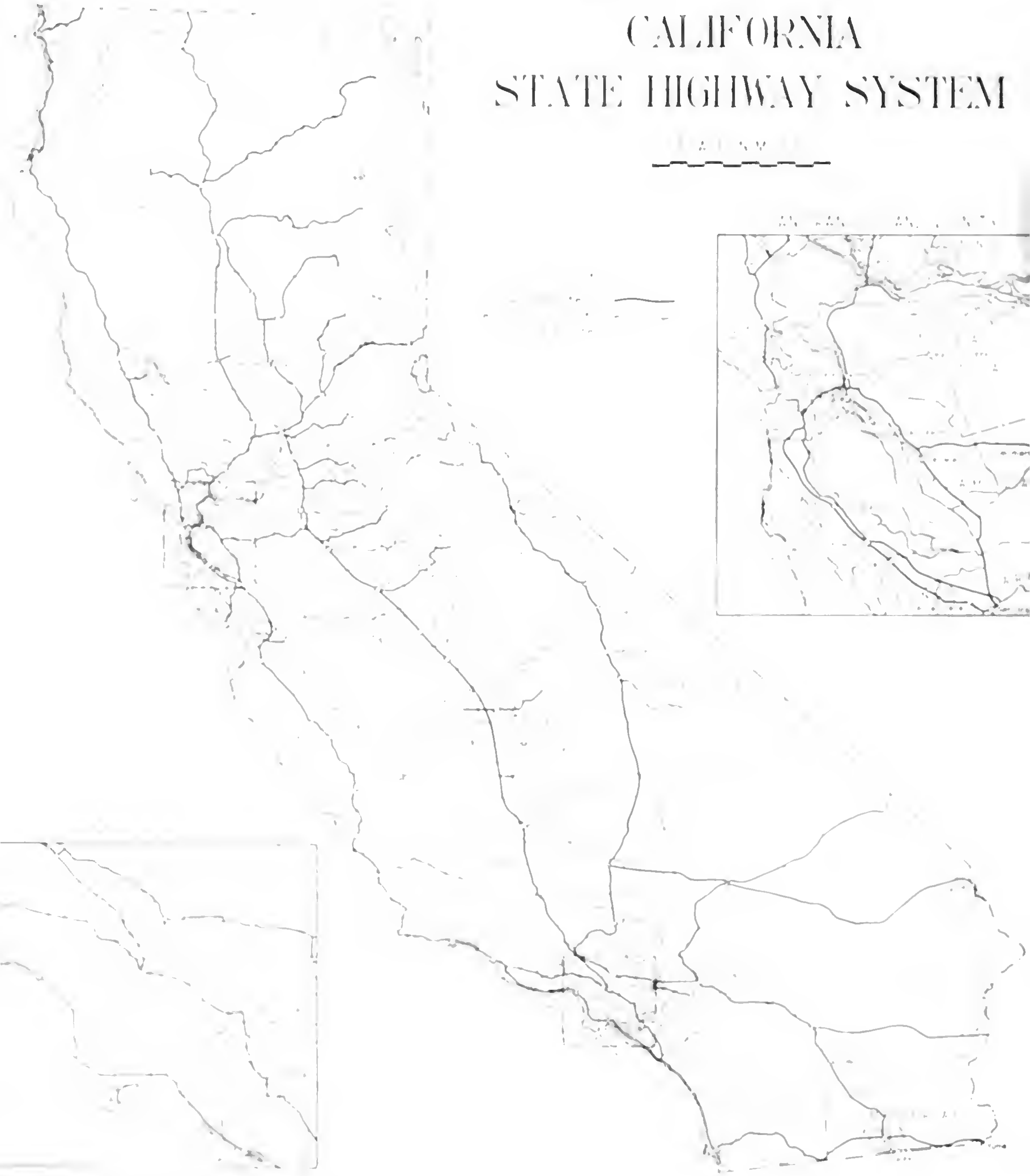

CALIFORNIA
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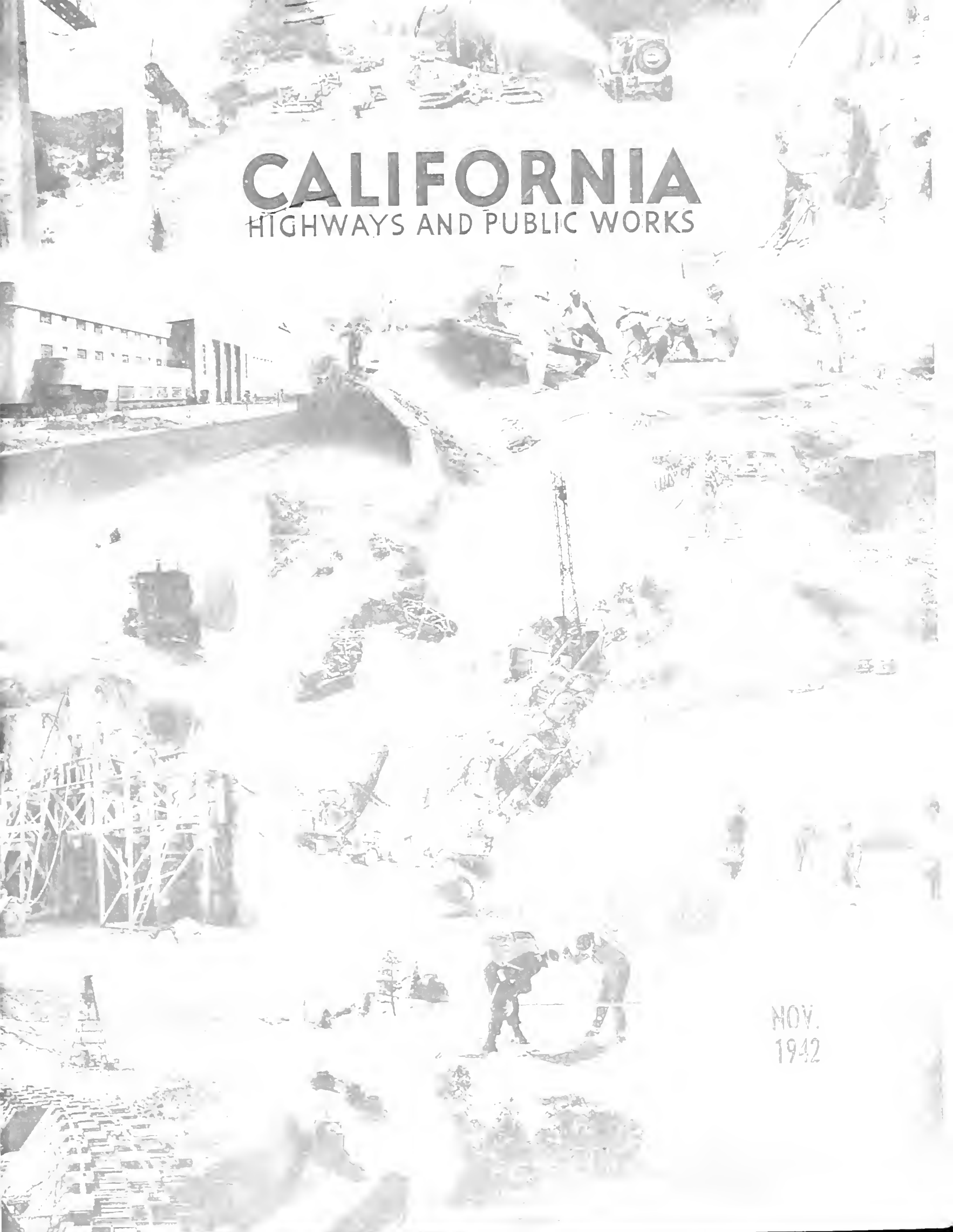

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CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California [PRINTED IN U. S. A.]

FRANK W. CLARK, Director C. H. PURCELL, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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Vol. 20 NOVEMBER, 1942 No. 11

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War Depletes Personnel of Division of Highways and Creates Serious Problem of Road Maintenance

By C. H. PURCELL, State Highway Engineer

THE war has created a serious problem for the State Division of Highways. We are confronted with the task of holding or obtaining sufficient trained personnel to maintain our highways, to complete the construction of the many going projects that are of vital importance to our war program and to make the necessary surveys and plans and handle the construction of other vitally needed projects.

Over 2,900 employees have left the service of the Division of Highways since January 1, 1941, and at the present time others are leaving at the rate of about two per day. Many have entered the armed forces; others have resigned to accept employment elsewhere. Replacements are increasingly difficult to obtain and at several locations in California, due to the scarcity of men and the difficulty of obtaining living quarters, it has been impossible to fill the vacancies.

In spite of our best efforts in recruiting new personnel, we have approximately 1,300 fewer employees now than a year ago.

During the past several months survey, plan and construction work has been steadily increasing due to many access road and emergency flight strip projects being added to our program. On October 1st of this year, 124 contracts were under way, 46 of which were access road or flight strip projects. The estimated cost of completing these contracts was $13,553,000. In comparison, the estimated cost of completing contracts under way on October 1, 1940, was $8,645,000.

It is interesting to note that on October 1, 1940, there were 1,285 engineers employed by the Division of Highways, while only 1,122 engineers were on the pay roll on October 1, 1942. In addition to the 124 going contracts, 52 other projects, estimated to cost $9,378,000, have been certified for construction by Federal authorization.

In several sections of the State, maintenance work has increased greatly, due to military traffic and hauling to defense establishments causing heavy damage to highways. With winter coming on there is a strong possibility of having some of our roads closed unless replacements can be obtained. It is estimated that a minimum of an additional 100 equipment operators and 200 laborers will be required to maintain our roads during this coming winter.

The many Federal war measure regulations relating to highway construction and maintenance have also added on a tremendous amount of additional work, and only through our employees working long hours has it been possible to keep up with the heavy survey, construction, and maintenance program. Many projects are undermanned and in some cases untrained employees are being used for work that they would ordinarily not be assigned to.

The following figures indicate the seriousness of our personnel situation:

MANY IN U. S. SERVICE

	Number of employees who have left the employment of the Division of Highways subsequent to January 1, 1941		
	Military Leaves of Absence	Resignations	Total
Engineering personnel	175	616	791
Maintenance personnel	159	1,568	1,727
Clerical personnel	40	313	353
Miscellaneous	12	46	58
Totals	386	2,543	2,929

EMPLOYEE LOSSES

	Total Number of Highway Employees			
	July 1941	January 1942	July 1942	October 1942
Engineering personnel	1,457	1,257	1,175	1,122
Maintenance personnel	3,297	3,380	2,529	2,439
Clerical personnel	710	742	716	724
Other personnel	342	333	334	297
Total pay roll	5,806	5,712	4,754	4,582

(Continued on page 9)

Strategic Network and Access Roads Defined

"A great many people have the idea that the strategic network of highways is a system of military roads separate from the ordinary highway system of the nation. It is nothing of the sort," Brig. Gen. Philip B. Fleming said in a recent statement. "The strategic net-work is simply that part of the nation's highway system which the War Department has designated as most important for military improvements.

"Since Pearl Harbor, highway building and maintenance have had to be sharply curtailed. With a few notable exceptions the Public Roads Administration, through which the Federal Works Agency carries on its federal aid highway program, is concentrating on providing access roads in areas of military, naval or wartime industrial concentration, and on remedying critical deficiencies in the strategic network.

"Average length of the access roads is only about three miles. Those that do not form part of the primary or secondary systems of the States in which they are located are now being wholly financed from funds made available by the Defense Highway Act of 1941. Those that are a part of the State systems are financed from regular federal aid funds, except that the Government bears 75 per cent of the cost instead of the customary 50 per cent."

California Is Striding Ahead in the Conservation of Rubber

By JAMES M. CARTER, Director of Motor Vehicles and Chairman, State Highway Traffic Advisory Committee

CALIFORNIA has played a leading part in the Nation-wide effort to conserve vital war transportation almost from the time the country's rubber supply was cut off by hostilities in the Orient.

Because it was already in existence when the war started, the California Highway Traffic Advisory Committee to the War Department was recognized by the Secretary of War and the Office of Defense Transportation as the logical coordinating agency through which this work was to be done.

With the adoption of the Nation-wide conservation program by the ODT, the Highway Traffic Advisory Committee to the War Department was delegated as the national agency. The several State committees, of which the California group is one, were given charge of the program in their respective States. To localize the program and bring it closer to the people, war transportation committees were set up in every important community and administrators named to handle purely local problems.

The writer was named chairman of the California committee by Governor Olson. Serving on the committee are Charles H. Purcell, State Highway Engineer; Larry Barrett, chairman of the California Highway Commission, and E. Raymond Cato, Chief of the California Highway Patrol.

To facilitate the committee in carrying out the program, technical assistants were drawn from the Departments of Public Works and Motor Vehicles. J. W. Vickrey, Traffic and Safety Engineer of the Division of Highways, was appointed Executive Secretary and Arthur B. Waugh, Public Relations Counsel of the Department of Motor Vehicles, was appointed Director of Information. District Engineers of the Highway

JAMES M. CARTER

54,000 Communities Require Motor Transport

More than 54,000 communities in the country, as compared with 48,000 10 years ago, depend entirely upon motor transport, according to the 1942 edition of "Motor Truck Facts" now being released by the Motor Truck Committee of the Automobile Manufacturers Association.

Included in the information is the fact that of 741 war factories in Michigan, the average plant utilizes truck transportation to the extent of 65 per cent of incoming freight, and 69 per cent of outgoing freight.

In California with 5,533 communities, 1,868 of them, or 33.8 per cent are served only by roads.

WHY OUR COUNTRY MUST SAVE CARS AND TIRES

TODAY—7 out of 10 typical industrial workers depend on cars to get to work, 2 use public transportation and one walks.

NEXT JANUARY—out of every 10 tires on workers' cars today, 4 will be worn out.

AUGUST, 1943—8 out of every 10 tires will be worn out; public transportation will be available to only 4 out of 10 workers when their cars give out.

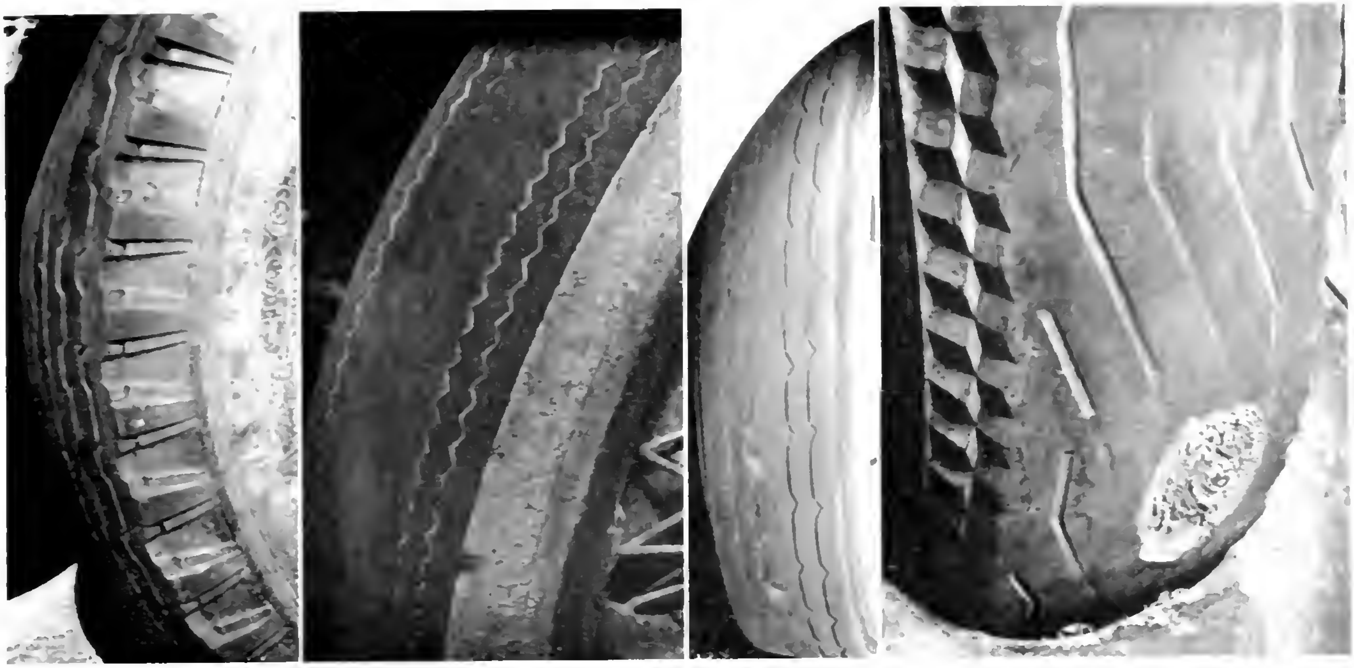
West Virginia Road Commission Survey

57 Per Cent of All Car Mileage Is For Business

Some interesting facts concerning the use of automobiles are revealed in the latest issue of Automobile Facts and Figures magazine.

Car mileage for strictly business purposes averages 57 per cent for all States. Automobile trips for necessity uses amount to 77 per cent and trips for recreational and social uses are given as 23 per cent.

Some other interesting facts in connection with automobile use are that the oldest cars have a high percentage of necessity driving and commercial travelers have the highest mileages while physicians make the most trips.



Tire on left shows result with wheel out of balance or worn bearings, causing uneven wear and cup-like indentations. Next tire shows wear on side because wheel is out of alignment. Third view, a combination of bad wheel alignment and bad brakes cause wear on one side and spots on tread. Right picture shows what happens when you have rough, catching spots on brake bands or egg-shaped brake drum, causing wheel to stop in one position and wearing hole in tire.

Division were named assistant secretaries to act in their respective areas and highway patrol inspectors and captains were designated as coordinators in their areas. Highway engineers and attaches were borrowed to make surveys and give other technical assistance.

COMMITTEE OBJECTIVE

The committee adopted as its objective the conservation of vital war transportation by the prolongation of all rubber-borne transportation facilities now in use and the maximum use of mass transportation facilities. The methods proposed to carry out this program were:

1. Systematic staggering of store, office, industrial and school hours.
2. Planned neighborhood-by-neighborhood group riding to and from stores, offices, industries, and schools based on common destinations.
3. Regulation of street and highway traffic to make possible more safe and efficient use of vehicles.
4. Securing compliance with speed regulations as proposed by the President and Governor and later by the Rubber Administrator.

Means to Save Rubber Suggested by Jeffers

Rubber Director William M. Jeffers has asked all newspapers to carry a special message on tire conservation "as frequently as possible" from October 5th until the start of Nation-wide gasoline rationing about November 22d.

Jeffers offered a suggested text for a one or two column box and said he hoped each editor would consider the request as "a personal appeal from me."

The suggested text:

A message to every driver:

You can save rubber and help win the war if you will do these things:

1—Drive only when absolutely necessary.

2—Keep under thirty-five miles per hour.

3—Keep your tires properly inflated.

4—Have them inspected regularly.

5—Share your car with others.

—WILLIAM M. JEFFERS

5. Encourage individuals, groups and agencies to use any additional methods to conserve vital war transportation.

Throughout, it has been the policy of the committee to work with the city administrators and war transportation committees within their geographical jurisdictions in an advisory and stimulative capacity.

The work has gone forward smoothly and effectively. War transportation committees and administrators have been appointed in every California city with a population over 10,000 and in a number with a population somewhat less. These agencies are all carrying out a conservation program in keeping with their own local problems but based on the general principles of the ODT plan.

COORDINATORS NAMED

In the Los Angeles Metropolitan and the San Francisco areas, special committees and coordinators have been named to handle the difficult and intricate problems of conservation and mass transportation peculiar to those communities.

Active support is being given all of these agencies by the State Highway Traffic Advisory Committee.

Realizing that the greatest problem confronting it was to reach the indi-

(Continued on page 19)

Highway Culvert Location and Slope From a Review of California Practice

R. ROBINSON ROWE, Assistant Engineer, Bridge Department
G. A. TILTON, Jr., Assistant Construction Engineer

FOREWORD

This is the third of a series of technical abstracts from a joint departmental review of culvert practice of the California Division of Highways by a committee composed of Clarence E. Woodin, Assistant Maintenance Engineer, Robert L. Thomas, Assistant Engineer, Surveys and Plans; and the writers. Following the preliminary outline of subjects in the August number of the California Highways and Public Works, the series opened with:

September issue: Comparative Hydrology Pertinent to California Culvert Practice; October issue: Debris Control at Culvert Entrances on California Highways.

The series continues with a discussion of culvert location with respect to the natural channel. Typical locations are named, defined and compared with recommendations. Obviously horizontal and vertical locations are not independent but the two subjects are developed separately for easier reference. The vertical location involves the consideration of slope, for which new guides are presented.

Culvert Locations Defined

Bottom Location

Culvert located in approximate line and profile of natural channel.

Modified Bottom Location

Culvert entrance in bottom of natural channel and outlet projecting from embankment slope.

Sidehill Location

Culvert entrance and outlet well above bottom. Wrong: On an unstable berm. Right: In trench or on solid berm.

Top Location

Culvert entrance and outlet near roadway grade, well above bottom.

Diversion Location, Normal

Culvert normal to roadway, diverting a skewed stream at entrance or outlet or both.

Diversion Location, Preferred

Small skews eliminated, moderate skews retained, large skews reduced.

Transverse Relief Location

Culvert located transverse to roadway to intercept gutter flow at regular intervals.

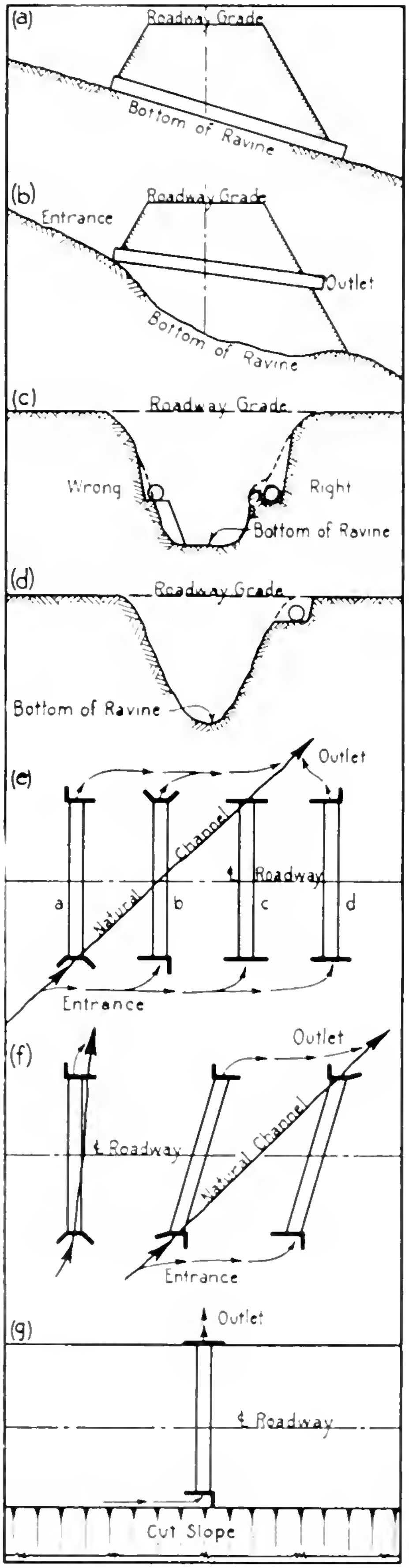


Figure 12

(d) will usually be a *Sidehill Location* and should be studied as such. Rarely, in a U-shaped valley, this alignment will resemble a *Bottom Location*, with the advantage of dry trench or structure excavation, but with all the disadvantages of alternatives (a) and (c) combined.

REDUCTION OF SKEW

One point should be emphasized as a general criticism of alignment in *Diversion Location*. Reduction of skew should be considerate of extra cost of skew construction and of channel change and maintenance. At one extreme, consider a box culvert 100 feet long on a 3 degree skew. Extra cost of framing the skew structure would probably exceed the alternative channel adjustment (about 5 feet) for a normal alignment. At the other extreme, suppose the channel skew was 45 degrees, a normal culvert would appear to save 41 feet of conduit by adding 100 feet of channel work. But an 8 degree skew culvert would have saved 40 feet of conduit by adding only 86 feet of channel.

Hence, as a general rule, small skews should be eliminated, moderate skews retained and large skews reduced—the limits being determinable for each site by cost comparison. Accordingly, the second illustration of *Diversion Location* **(Figure 12 f)** indicates the preferred locations.

SLOPES GENERALLY

In the September installment, it was recommended that culverts be designed to carry a 10-year flood without static head (on crown at entrance) and that balanced design of culvert and appurtenances be based on the 100-year flood. Either of these rules may (for some particular site) determine size of culvert or its gradient. Generally, however, the first rule will determine only a minimum waterway area and the second will yield balanced combinations of area, gradient and conduit texture for cost comparison.

Since gradient assumes its greatest importance when considering the rule for a 100-year flood, we have defined *critical slope* as the gradient which will just carry the 100-year flood with a full waterway.

CHARTS PRESENTED FOR COMPUTATIONS

Chart C **(Figure 15)** has been prepared to show the relationship between full capacity and critical slope for culverts of concrete or corrugated

Figure 13a. Bottom Location—reinforced concrete arch on curved alignment and uniform gradient in bottom of ravine. Figure 13b Bottom Location—reinforced concrete arch on straight alignment and broken gradient. Figure 14. Modified Bottom Location—corrugated metal pipe, with entrance in bottom of ravine and alignment following grade tour in sidehill trench, to an outlet well above and to one side of natural channel.

metal. The relationships were derived from published (1) (2)* discharge formulae and depend upon size, shape and texture of the conduit, but not its length. For circular sections, the slope is obtained in one step with the isopleth (computation line drawn on nomograph, or represented by a straight edge) intercepting the 100-year flood on the discharge scale and the diameter scale corresponding to the pipe material. For non-circular sections (box or arch) of cast-in-place concrete, there are two steps, the first isopleth intercepting perimeter and area scales to obtain a turning point on the diameter scale, whence a second isopleth through the discharge obtains the critical slope.

Before applying this chart, a minimum conduit section should be determined from the 10-year flood criterion, remembering that the 10-year flood is only 55 to 65 per cent of the 100-year flood. Chart D **(Figure 16)** gives this directly for circular conduits and a series of isopleths rotated through the 10-year flood on the discharge scale will give a series of equivalent rectangular box dimensions.

EXAMPLE

The following example illustrates the use of the charts. Suppose for a certain culvert site that we have estimated the 100-year flood at 250 and the 10-year flood at 145 second-feet. From Chart D (Q=145) the least diameter for a circular section is 60 inches. For this first criterion, it is presumed that there will be no backwater in the barrel; hence, **capacity is governed by size and shape of entrance, regardless of slope and texture of the conduit.** From Chart C, (Q=250) the critical slope is 0.71 per cent for a spun (centrifugally cast reinforced-concrete) pipe, or 0.95 per cent for a cast (reinforced concrete) pipe, or 3.85 per cent for a (corrugated) metal pipe. For the second criterion, **slope and texture of conduit assume importance.**

If any of these pipes is selected tentatively and laid on its critical slope, the depth of headwater pool above crown of culvert will just equal the entrance head. If laid on a flatter gradient the headwater stage will be increased; if on a steeper gradient, the headwater stage will not be affected, but the pipe will flow only part full, with velocity increasing towards the outlet.

Particularly, for a culvert 200 feet long, if the metal culvert were laid on a 0.95 per cent gradient instead of the critical 3.85 per cent, backwater stage would be increased by 5.8 [=200(.0385-.0095)] feet. On the other hand, if a cast pipe was laid on

* Numbers in parentheses refer to bibliography listed at end of this article.

a 3.85 per cent grade instead of its critical 0.95 per cent, pipe would flow only half-full at outlet with a velocity of 25.5 feet per second.

Usually the culvert slope will be determined approximately by the gradient of the existing channel, in which case Chart C will indicate the type of conduit which will pass the 100-year flood with least backwater and/or minimum outfall velocity. For this example, a box culvert would serve on slopes of 0.5 to 0.8 per cent, a cast pipe on slopes of 0.8 to 1.2 per cent and a metal pipe for slopes of 3.4 to 4.3 per cent. These ranges (illustrative only) do not cover extremely flat, very steep, or intermediate (1.2 to 3.4 per cent) slopes.

ADAPTATION TO ANY SLOPE

However, there are expedients available. For very flat slopes, there are two alternatives: either compute the backwater stage at culvert entrance and design protection therefor, or select a larger opening. If the natural slope was 0.3 per cent, Chart C will show that a 6 x 4 box culvert would cause 0.6 foot of backwater, which could be avoided by using an 8 x 4 box.

For very steep channels there will be no backwater, but the problem is to avoid erosion from high velocity of outfall. There are 4 alternatives: (1) The multiple culvert; (2) an extended culvert discharging at high velocity well beyond toe of embankment; (3) a projecting culvert with free fall at outlet; and (4) a broken-grade flow line. For any of these, the roughness of the metal culvert is a distinct advantage.

The first three alternatives are common practice and fields of application seem well understood, but the fourth is rarely used. The theory is best explained by the preceding example, assuming a 15 per cent slope for the natural channel. If the 60-inch by 200 foot metal pipe is laid on this uniform slope, outfall will be half-section at 25.5 feet per second. If the grade is broken by laying the upstream half on a 26 per cent and downstream half on a 4 per cent gradient, then outfall will be full-section at 12.8 feet per second. True velocity will be high (30± feet per second) in the upstream half, but this disposes of much of the excess energy in increased friction. The excess kinetic energy at grade break is lost in turbulence common to sudden expansions of wetted section; at some stages this loss will [illegible]

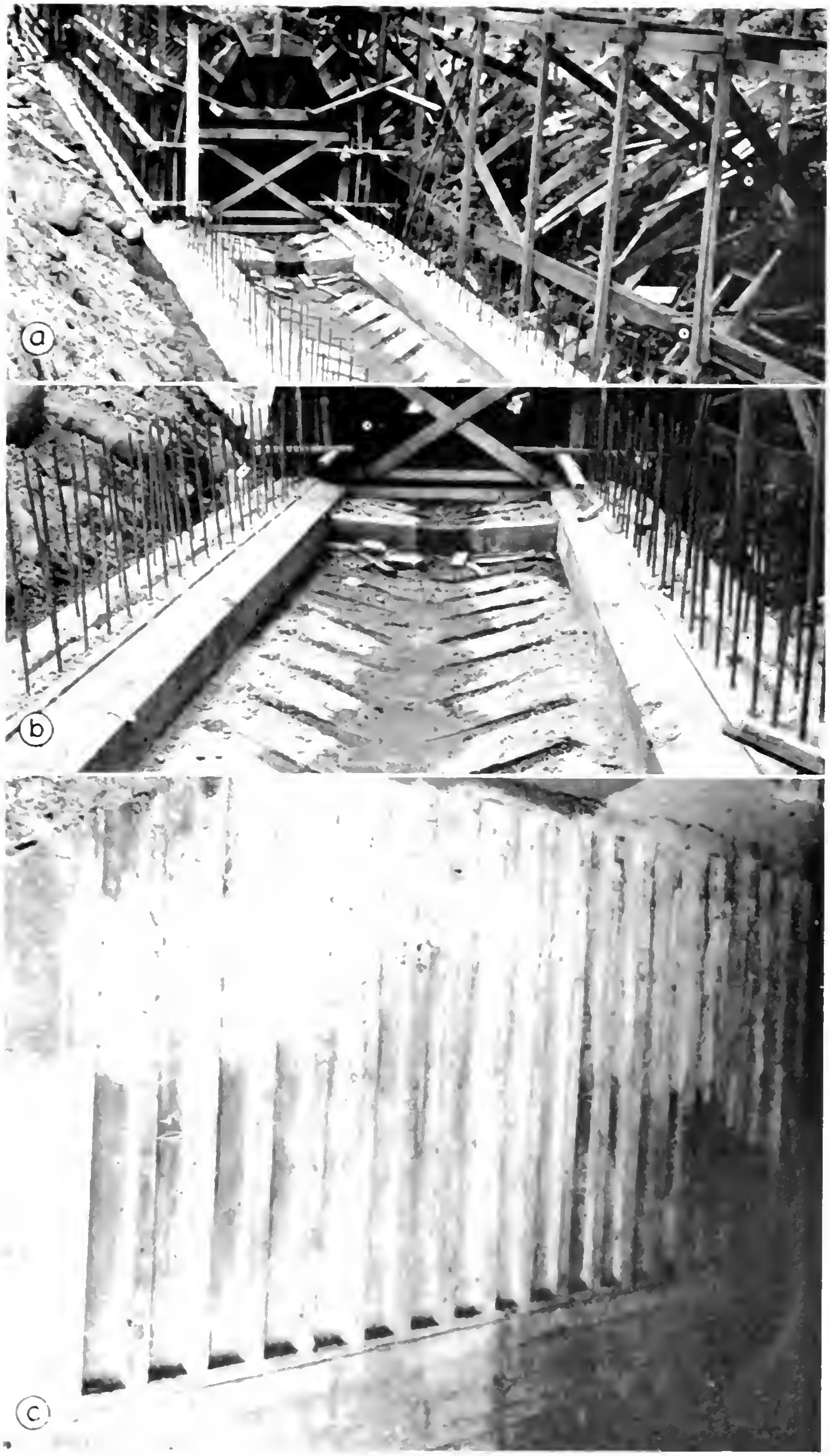


Figure 17—a, b. Invert steps and herring-bone roughening to create turbulence and reduce outlet velocity. c. Fluted sidewalls to further reduce velocity. (McNamee Creek, I-Men-56-A.)

For the intermediate range, modifications of either metal pipe or box

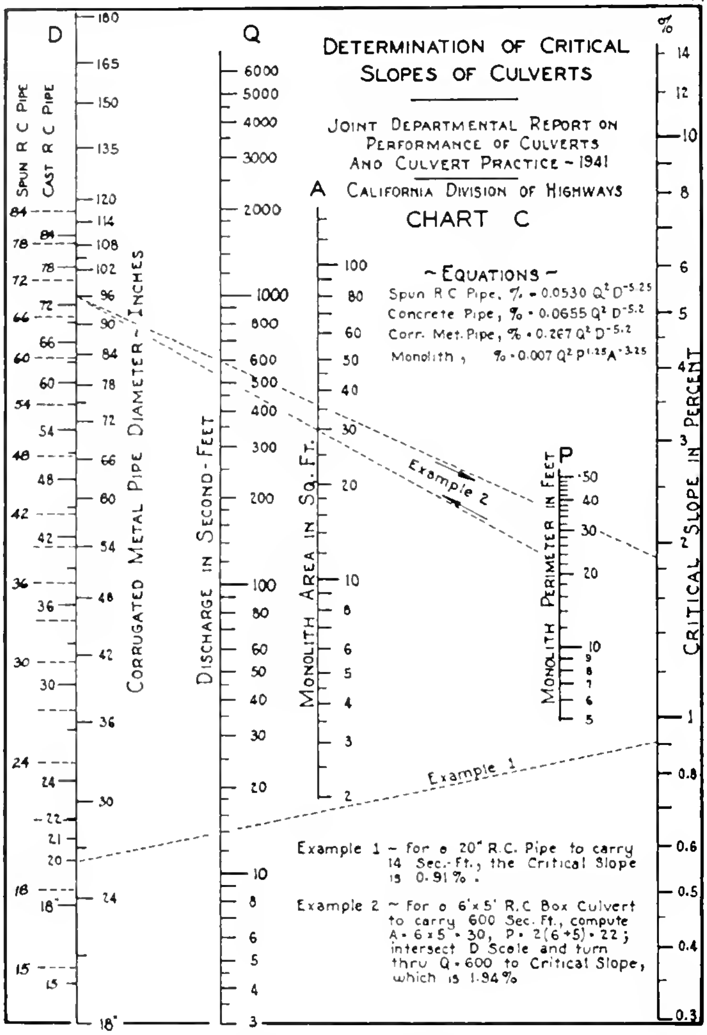


Figure 15. Chart for computing optimum culvert slope from estimated 100-year flood.

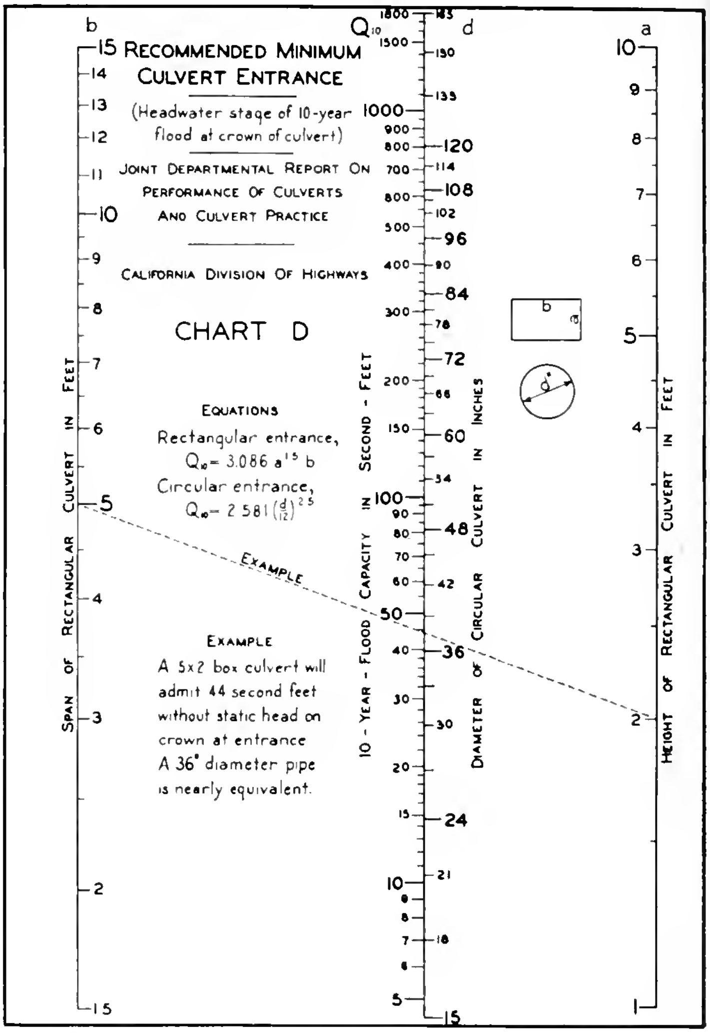


Figure 16. Chart for determining minimum culvert entrance section from estimated 10-year flood.

culvert are practical. For the metal pipe, the backwater stage can be computed and headwalls designed accordingly, or a larger pipe may be specified. The box (or arch) culvert can be roughened, or its grade broken, or its invert stepped, or high velocity anticipated at outlet. For the example, if natural slope is 1.5 per cent: (1) a 60-inch metal culvert would create 4.7 feet of backwater; or (2) a 72-inch metal culvert would just eliminate backwater; or (3) a 6 x 4-foot box culvert could be provided with outlet protection designed for effluent velocity of 17.7 feet per second; or (4) the box culvert could be laid on successive gradients of 2.4 per cent and 0.6 per cent, broken at midpoint; or (5) the box culvert could be laid on its critical slope (0.6 per cent) with invert stepped down 0.9 foot at each third point; or (6) the inner surfaces (or a proper portion thereof) of the box culvert could be built rough or (7) 160 feet of cast RC pipe at 0.95 per cent gradient could be followed by 40 feet of metal pipe at 3.85 per cent, saving some excavation.

EXPERIMENTAL CULVERT

Alternatives (5) and (6) have been combined in an experimental arch culvert **(Figure 17a-c)** at McNamee Creek (1-Men-56-A). Here the natural channel slope was 3.8 per cent; 50-foot steps with 0.9 foot risers reduced the effective gradient on the steps to 2.0 per cent. The barrel was the standard 73-sq.-ft. arch by 252 feet long under a 60-foot embankment. Its invert was roughened in a herring-bone pattern by pressing 2 x 6's down in fresh concrete. The walls below springing were fluted by nailing scabs to the forms.

Several other types were suggested to the committee, but disapproved because of hazard of blocking by drift. One, which would be very economical for clear water on a steep slope, provided a normal entrance waterway, contracting at once to increase velocity and friction, then expanding near outlet to regain low-velocity outfall. Others provide baffles or weirs, as for canal chutes and drops.

The hazard of silt deposit in culverts laid on flat gradients is well known. To avoid such deposit, culvert slope must assure a velocity throughout its barrel greater than the ruling velocity of the stream—not only at flood stage, but at all stages of roily flow. For some sites, this principle will warrant laying culverts on gradients somewhat steeper than critical. This is particularly applicable to box culverts, but sufficiently high velocity at low stage may be gained by shaping the invert like a broad, flat V.

Summarizing its findings, the committee recommends generally that:

(1) Culverts be located to fit natural channels in line and grade, following moderate curvature and breaks in grade in so far as practical.

(2) For modified bottom or sidehill locations, culverts should be entrenched in firm material beyond probable plane of rupture. At such locations, the outlet site should be so selected that protection against scour will be practical.

(3) For any but the bottom location, economy in first cost must be justified by a showing of adequacy for all contingencies and of tolerable maintenance charges.

(4) Transverse relief locations on long grades should be specified at intervals not exceeding 300 feet.

(5) For a diversion location in a skew channel, culvert entrance should intercept the flow as directly as practical. Economy will lie in total elimination of small skews, retention of moderate skews and reduction of large skews—all subject to permissibility of channel change at outlet.

(6) As one step in balancing design for the 100-year flood, the locator or designer should select a combination of conduit and gradient that will carry that flood with full section to (or nearly to) the outlet, so as to control the velocity of effluent.

(7) The gradient selected should assure culvert velocity equal to or greater than ruling velocity of the stream at all stages of roily flow.

(8) Grade-breaks, stepped inverts and artificial roughening may participate in the selection, but baffles, weirs and contracted sections should be avoided for all surface run-off.

Bibliography

(1) Flow of Water through Culverts (Bulletin 1, University of Iowa, Studies in Engineering, 1926).

(2) Flow of Water in Concrete Pipe (F. C. Scobey, Bulletin No. 852, Dept. of Agriculture, 1920).

The dinner guest's nose was exceptionally large, and father had noticed Willie staring at it. Expecting the boy to make some frank and outspoken comment, he gave him a disapproving glance. "That's all right, dad" came the reassuring response. "I'm not going to say anything. I'm just looking at it!"

In Memoriam

Clifford David Good

June 9, 1897 — September 25, 1942

The sudden and untimely passing on September 25th of Clifford D. Good, of the legal staff representing the Division of Highways at San Francisco, caused deep sorrow to all his friends and associates. He had been in State service since December, 1934, when he was appointed to a position as condemnation investigator and trial attorney where his genial and generous personality won him many friends.

Clifford David Good was born June 9, 1897, in Meckling, S. D. He attended Graham Grammar School in Los Angeles, Los Angeles High School, and the University of Southern California. He was admitted to the practice of law before the District Court of Appeal on the ninth day of August, 1920, in San Francisco.

He was married March 1, 1921, to Pearl Stover, of San Francisco. The widow, a son, George, and the decedent's mother, Mrs. Jennie W. Good, survive him.

Bids and Awards for October, 1942

ALAMEDA COUNTY—Between Distribution Structure and University Avenue, about 2.5 miles to be widened with Portland cement concrete and the existing pavement to be surfaced with asphalt concrete. District IV, Route 69. Piazza and Huntley, San Jose, $290,133. Contract awarded to Lee J. Immel, Berkeley, $277,035.

LOS ANGELES COUNTY—On Stewart St., Exposition Blvd. & Dorchester Ave. in the city of Santa Monica, about 0.9 mile to be surfaced with plantmixed surfacing. District VII. Contract awarded to Griffith Co., Los Angeles, $46,345.

MONTEREY COUNTY—Between Salinas and ¼ mile north of Santa Rita, about 2.9 miles to be graded and paved with Class "B" Portland cement concrete and a timber bridge to be widened. District V, Route 2, Sections A,J. Contract awarded to Granite Construction Co., Watsonville, $261,212.

ORANGE COUNTY—On Katella Avenue and Denni Street, between Los Alamitos Blvd. and Farquhar Avenue, about 1.3 miles to be graded and surfaced with plantmixed surfacing. District VII. Contract awarded to Griffith Co., Los Angeles, $69,401.

SAN DIEGO COUNTY—Furnishing and installing traffic signals system at Barnett Avenue and Midway Drive and at Lytton Street and Rosecrans Street on Route 12 in the city of San Diego. District XI. Contract awarded to Econolite Corp., Los Angeles, $4,900.

SOLANO COUNTY—Tennessee and Georgia Streets, between Vallejo and Route 7, about 1.1 miles to be graded and surfaced with plantmixed surfacing. District X. E. A. Forde, San Anselmo, $73,117; Chas. L. Harney, San Francisco, $78,863. Contract awarded to A. G. Raisch, San Francisco, $68,415.

War Depletes Personnel of Division of Highways

(Continued from page 1)

It will be noted from the foregoing that the largest percentage of departures are in the engineering and maintenance personnel classifications. It will also be noted that the number of employees resigning to accept employment elsewhere is greater than those leaving to enter the military service.

In practically all lines of work, our personnel may find other employment at increased pay and in some cases the necessity of increasing earnings to cover increased cost of living has practically made it necessary for the employee to leave the Division of Highways. In several other cases employees have resigned to enter defense work with the hope that they would be deferred from the draft.

In the past it has been the practice of the Division of Highways to employ college engineering students, during the heavy Summer construction period, to assist in engineering work. These students have been assigned to such duties as chainmen and rodmen on survey work, load checkers and weighmen on surfacing projects, and as office assistants. It is expected that, prior to the Summer of 1943, most of these young men will be in the military service and that it will be necessary for the State to look elsewhere for engineering assistants. The Department is now looking for qualified women to place in some of these positions.

Employees who have remained in the State's service during this emergency are to be commended for their conscientious endeavor to keep the work rolling, and we all know that these men and women will willingly continue their long hours of work and do everything in their power to insure that highways, which are so important to the war program, will be constructed and will be maintained.

The Division of Water Resources and Division of Architecture have contributed also to the armed forces.

The following Division of Highways employees are now in the military service:

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ITECTURE

A. A. Sauer
A. P. Weadock

This stretch of new Watsonville-Rob Roy highway shows easy grade alignment and sight distance advantages.

New Watsonville-Rob Roy Route

THE last of three contracts on the Watsonville-Rob Roy Junction project in Santa Cruz County was completed during the middle of last month and the new highway was opened to traffic on Saturday morning, October 17th.

Saving more than two miles in travel distance between Watsonville and Rob Roy Junction, this project is of importance to the Pajaro Valley. It eventually will run to Santa Cruz.

On December 2, 1940, the first contract, calling for the grading of 6.2 miles from the northerly end of Main Street in Watsonville to a point 1.6 miles south of Rob Roy Junction and involving the expenditure of $285,481.77 of State and Federal Aid funds, was awarded.

The second contract was awarded on October 20, 1941, and provided for a crusher run base on the entire 7.8-mile section and the grading of 1.6 miles south of Rob Roy Junction. This contract was for $372,654.98.

On June 12, 1942, the third contract, providing for an armor coat surfacing from Watsonville to Rob Roy Junction was awarded and the completion of this job at a cost of $64,842.23 made possible the opening of the new highway on October 17th.

The present three-lane highway will relieve heavy traffic congestion which the old road was unable to handle. The new location lies between the old road and the coast line, and crosses several ancient tidal channels which had filled up with alluvial waste and vegetable matter in the form of peat land. The peat formation in these areas varies in depth of from 10 to 43 feet.

Special foundation treatment to support the superimposed load placed thereon by the highway fills was required. Test borings determined the character and depth of the peat formation and foundations at Harkins and Watsonville Sloughs were stabilized by constructing vertical sand drains to permit the escape of ground water as pressure was applied to the surface by placing the fill. These drains were constructed by drilling wells 20 inches in diameter through the peat formation, spaced on 13-foot centers parallel to center line and on 11-foot centers at right angle to center line.

Clear water was injected into the wells and removed by a suction pump, which carried away the silt and sediment. This process was continued until the water ran clear, after which the wells were backfilled with a clear graded sand. A 3-foot sand blanket was placed over the entire area to provide a drainage outlet from the sand drains.

The 35-foot fill at Harkins Slough required approximately 70,000 cubic yards of material and at Struve Slough, 84,000 cubic yards of fill material was placed, 35,000 cubic yards of which provided for subsidence and displacement of the peat land foundation.

Some of the major contract items:

1,225,000	cubic yards road excavation.
16,190	lin. ft. of 20″ diameter drilled wells for fill stabilization at slough crossings.
9,000	lin. ft. of corrugated metal pipe of various diameters.
490	cubic yards concrete.
60,000	lbs. reinforcing steel.
10,000,000	sta. yds. overhaul.

Two views of three-lane highway between Watsonville and Rob Roy Junction which [illegible] two-lane road and [illegible] traffic congestion in Pajaro Valley. Highway ultimately will extend to Santa Cruz.

Palm trees on right were moved and reset outside of curb line. Palms on left were left in place.

Riverside Has New Divided Highway

By A. E. SMITH, Assistant District Construction Engineer

THREE [illegible] State Highway [illegible] under way [illegible] early [illegible] a four-lane divided highway [illegible] Riverside [illegible] about [illegible] Perris. This is a portion of the Inland Route to San Diego [illegible] U. S. Highway [illegible]

[illegible]

Riverside along the Box Springs Grade to the overhead crossing over the tracks of the Atchison, Topeka and Santa Fe Railway Company near Box Springs Station.

DIVIDING STRIP

On this portion for the greater part a 30-foot central dividing strip was constructed between the near edges of the two pavement placed on dual roadway sections. Each roadway section was paved with two standard [illegible] Portland cement concrete [illegible] inches in thickness [illegible] Shoulders were constructed [illegible] plant-mixed surfacing [illegible] asphalt as binder. [illegible] constructed in [illegible] the top of the slopes [illegible] distance from center line. As the height of each cut decreased the slope thus became flatter, terminating at the daylight point. In addition, the tops of the slopes were rounded. The result was a uniform blending of the roadway excavation slopes with the adjoining terrain that produced a naturalistic appearance, free of construction scars. Top soil was placed uniformly over these slopes and is to be seeded to grass to check erosion until native plant growth has been established.

Near the City of Riverside the four traffic lanes were brought together, by omission of the dividing strip, to conform to city street sections ahead. In this area it was necessary to move many large palm trees to provide for the wider roadway section. These palms were moved and reset outside

(Continued on page 20)

Top—View west. Pepper trees previously bordered old two-lane road. One row now in dividing strip. Center—Dual roadway sections each paved 23 feet in width. Dividing strip is 30 feet wide between near edges of pavement. Bottom—View west. Island between traffic channels constructed of bars made of plant-mixed surfacing and painted white. Grade separation structure in center.

Quick Method Devised For Placing Asphalt Concrete Pavement Bars

By BLAIR GEDDES, Assistant District Traffic and Safety Engineer

FACED with a specific problem involving installation of raised pavement bars in an area of high traffic concentration, the City and County of San Francisco and Daly City in San Mateo County, working in cooperation with engineers of the Division of Highways, have done some extensive experimenting with precast asphalt concrete bars.

These bars have been installed in advance of streetcar safety zones at each intersection. They have been placed at varied angles and varied spacings to provide opportunity to study their effectiveness and to determine the most advantageous arrangement.

City Engineer R. A. Klassen of Daly City evolved a new variation which is proving a success. Realizing that it would be impracticable to maintain barricades to protect plant-mixed bars during the curing period and desiring a more substantial job than can be obtained with that material, he decided to experiment with asphalt concrete. The result exceeded his expectations.

The bars were placed in advance of safety zones adjacent to street car tracks with nine bars on eight foot centers at each zone.

PLYWOOD FORMS USED

Eighteen forms were constructed of one-quarter inch plywood with one by four strips fastened on top, rabbeted at the edge, to provide a track for the finishing tool. The inside edges of this form were champfered on a 45 degree angle to allow removal of the form without disturbing the completed bar.

Finishing tools consisted of two metal floats and a small tamper for finishing the ends. The floats were constructed of pieces of salvaged steel plate which were cut almost in two along the center, then formed to the proper shape and the opening filled with an electric arc. An iron wheelbarrow with a wood fire was used to transport and heat the tools.

The mix used was Type C surface course and was obtained in quantities of one ton per delivery. With the eighteen forms it was possible to construct thirty-six bars before the material cooled to a point where it was not workable. This brought the requirements to approximately fifty-five pounds per bar, including loss from cooling in the truck.

The crew consisted of one truck driver and two laborers who performed all of the work including picking up the material at the plant and transporting it to the site of the work.

The placing procedure consisted of spotting the forms in place, chalk marking the pavement, then moving the forms aside, and painting the areas with emulsified asphalt for a tack coat. After the emulsion had set the forms were replaced in position and weighted down ready for the asphalt concrete to be placed and ironed off.

Immediately upon completing the zone the forms were removed and carried ahead to be spotted in position in a third zone while material was being placed in the second zone which provided for practically continuous placing of material, thus minimizing the excessive loss of material through cooling in the truck. By the time the last bar was placed in the fourth zone the first bars had cooled sufficiently so that the crew could return and clean up in the same rotation that the bars had been placed and remove the barricades, eliminating the necessity of maintaining barricades or lights over night.

Two coats of paint were applied to the bars, the first coat being applied the day after placing, the second coat, which included beads, being applied after all bars were completed on the project. The bars have been in place for approximately three months, and to date show no signs of ravelling, cracking, or staining of the paint.

BARS COST 85 CENTS

City Engineer Klassen estimates that the cost is approximately 85 cents per bar in place, exclusive of painting, including the cost of preparing tools and forms, but is confident that this cost can be appreciably reduced in future work where the project can be organized for continuous operations.

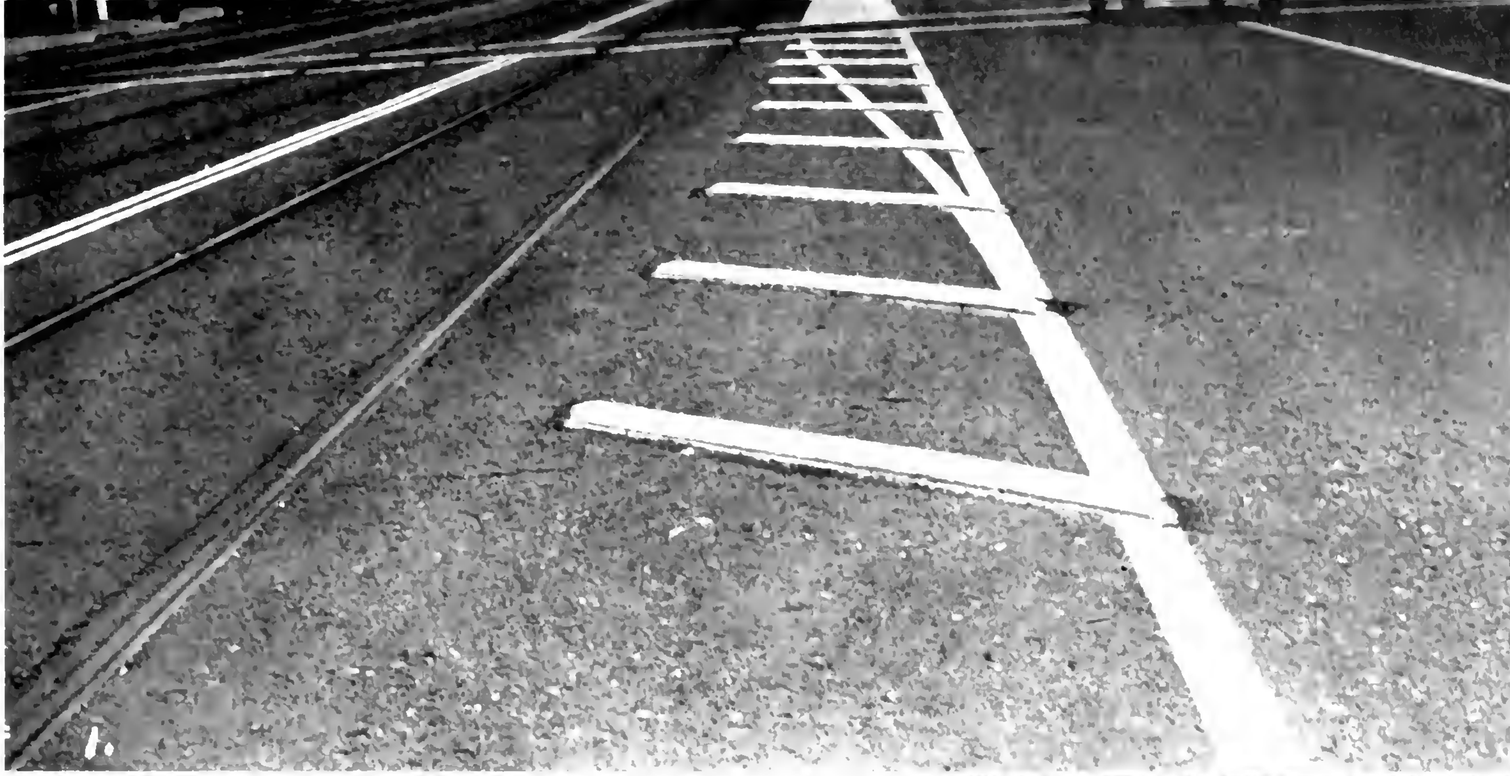
For additional bars which will be placed in the near future, Mr. Klassen intends to revise the shaping irons by increasing the crown to one and one-half inches in place of the present one inch to make an effective height of two inches per bar which will not only increase visibility but will also provide a more distinct reaction when cars strike.

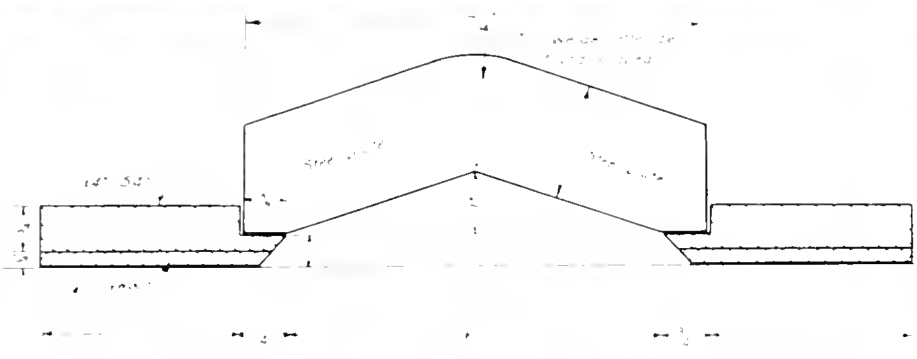
In San Francisco, bars placed to date on Van Ness Avenue have been installed in transitional pattern as shown in pictures 1 and 2. This type

Law Prohibiting Glass on Roads Rigidly Enforced

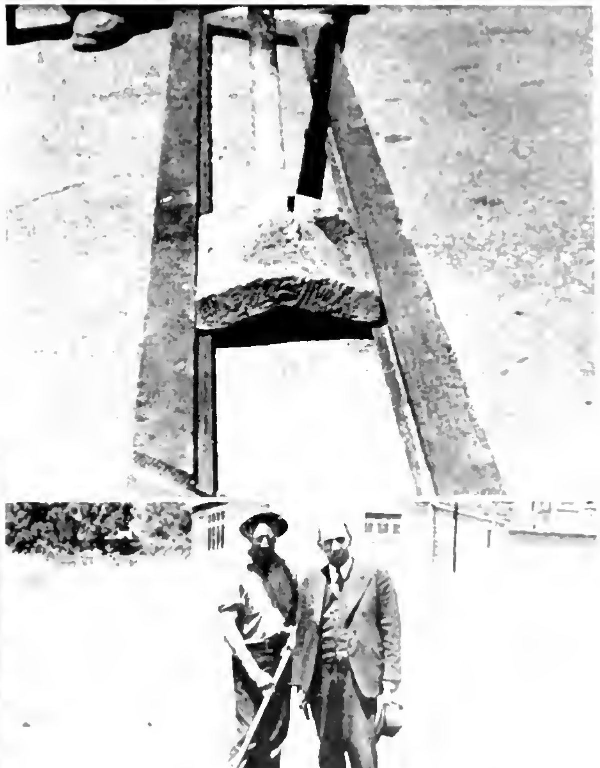
Section 601 of the Vehicle Code, making unlawful the throwing on any street or highway of any glass, nails or other substance which might injure auto tires, is being rigidly enforced. The person who, unintentionally or otherwise, leaves such material in the street is responsible for its removal. This includes headlight and other glass left on the pavement as a result of vehicular collisions.

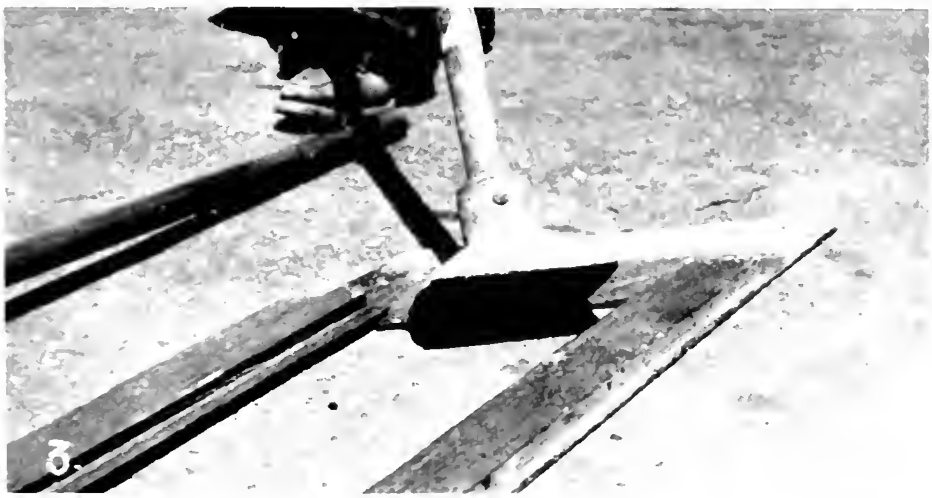
The necessity of placing and accepting responsibility in this matter is of paramount importance at this time. Widely scattered defense industries make thousands of workers dependent on personally-owned cars for transportation.





CROSS SECTION OF FORM AND SHAPING IRON





1—Durable, raised bars of asphalt concrete instead of plant-mixed bars placed in advance of safety zones adjacent to street-car tracks by use of plywood forms that rendered unnecessary the building of barricades needed to protect plant mix bars while curing. 2—Shaping iron on tracks in form. 3—Tamping iron for shape in ends of bars. 4—City Engineer Klassen of Daly City, who devised method, and equipment operator Cafferreta of installation required an adjustable form to make the varied lengths of bars. Forms consist of troughs made of timber and lined with sheet metal as shown in picture 3. Movable end fillets vary the length of bar and form the chamferred end. Mesh reinforcing is placed at the bottom of the bar on each side to provide additional strength. After casting and partial cooling, anchoring holes are punched near each end of the bar with a large spike, the forms are then inverted over a 2 x 6 board and the bar is complete. After a run of bars has been completed they are placed side by side, given a light cement wash and then painted with a spray gun.

The San Francisco installation procedure is as follows: The zone is marked and bar locations determined, proper length bars are laid adjacent to their final position, paint binder is applied to the area where each bar is to be placed and a thin course of A. C. is spread and leveled off to remove any irregularities in the pavement. The bar is then given a coat of paint binder on the bottom and slid from the board to its final position, spiked in place and weighted down with sand bags until the leveling course has cooled and set.

Complete breakdowns of cost items have not been made to date but preliminary checks indicate that the cost per completed bar in place will be somewhat less than $1.

One of the factors influencing the selection of this method of operation is the extremely heavy traffic on the streets where these bars have been and are to be installed. The truck which transports the material to the site can be unloaded in a limited time and then moved to a location which does not interfere with normal traffic flows. Another reason is that more tamping can be accomplished in the form than can be done while casting in place.

Summer Guest (disappointed): See here, your ad said that this hotel had a splendid view for miles. I see no such outlook.

Proprietor: Certainly, sir. Just stick your head out of the window and look straight up.

Top—Looking north on Van Ness Avenue from corner Pacific Avenue. Center—Looking south toward Jackson Street. Bars in foreground. Bottom—Casting form set for 4-foot bars.

California is Striding Ahead in the Conservation of Rubber

(Continued from page 3)

LAWRENCE BARRETT

E. RAYMOND CATO

vidual driver, the committee, at the outset, engaged in a State-wide program of publicity designed to acquaint the public with the seriousness of the rubber shortage. The press, radio and public forums were utilized for this purpose.

This, combined with active enforcement of the lowered speed maximum by the California Highway Patrol, brought an immediate public response. For several weeks there has been a continuous decrease in pleasure driving as well as a gradual lessening of speed.

Upon the issuance of the Nation-wide order by the Rubber Administrator setting the maximum speed limit at 35 miles per hour, the California Highway Patrol was given instructions to enforce this speed limit.

SPEEDERS WARNED

Enforcement of the order has been educational rather than arbitrary. Citations of arrest are issued only when conditions, such as worn tires, impaired vision or slippery pavements, are present which make driving above 35 per hour unsafe. In all other cases white warning cards are given the offenders and they are told they are violating their patriotic duty by exceeding the 35 mile limit.

Happily, there have been surprisingly few actual arrests considering the number of vehicles involved. The driving public is accepting the new speed limit voluntarily and, for the most part, graciously. Reports to the Rationing Boards and the power of the Department to revoke or suspend licenses, together with the patriotic attitude of the vast majority of our citizens, have brought about excellent observance of the new speed limit.

The prospect of gasoline rationing gives promise of solving the problem of conservation to a considerable degree insofar as the individual driver is concerned.

Plan $500,000,000 Post-War Highway Building Program

Brigadier General Philip B. Fleming, Federal Works Administrator, has announced that the first actual engineering work on post-war public construction—a projected highway building program to cost nearly $500,000,000—is well under way.

The engineering work, extending from conception of the improvements through surveys and the preparation of detailed plans and specifications ready for the contractors' bids, is going forward as a joint Federal-State undertaking. It is being financed from a special $10,000,000 fund which the Congress authorized in the Defense Highway Act of 1941 with the requirement that the States match funds for projects according to the usual Federal-aid plan.

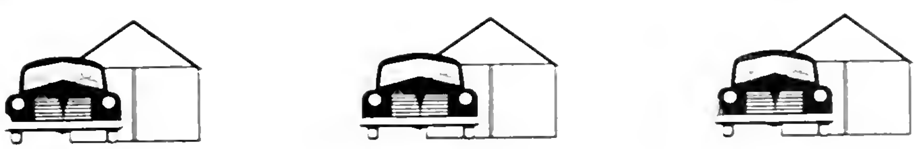
For that reason, the committee has decided to place greater emphasis on the group riding and staggered hours features of the conservation.

To encourage the formation of group riding clubs approximately 500,000 cards have been printed and are being distributed to the various local war transportation committees.

GROUP RIDING

The purpose of these cards is to locate persons desirous of obtaining rides and to get them in touch with others having a common destination who have cars they are willing to share.

(Continued on page 20)



PEACE-TIME PRACTICE — 3 cars take 5 persons to work (1.6 persons per car) for 18 months (average life expectancy of each car)

GROUP RIDING — same 3 cars (used in weekly rotation) transport the same 5 persons (5 to a car) for 54 months

(Continued from page 19)

Group riding groups already are functioning at the numerous defense plants with good results. It is hoped by the new plan to extend the plan to business and professional men with common destinations. Housewives are being encouraged to form such clubs to carry children to and from school and for routine shopping.

Staggered hour plans are being operated in various parts of the State, notably Los Angeles and San Diego, with marked success. The effect of these programs, wherever tried, has been to reduce the burden on street cars and buses during peak hours when congestion is very heavy.

The committee feels this is a prolific field for further effort and is lending encouragement to local committees to sponsor such movements. Committees named by the Railroad Commission and by the Los Angeles coordinator have done much to encourage staggered hours in the crowded Los Angeles and San Francisco areas.

In carrying on its program of conservation, the committee has had the active cooperation of the State Council of Defense, the Office of Price Administration and the various local representatives of the Office of Defense Transportation.

Inasmuch as the rubber shortage promises to be acute for many months the committee feels there is still much work to be done. The task of conserving vital war transportation should be a continuous one. Although the public is fairly well informed on the subject there must be no letup in public education.

Driving must be confined strictly to the essentials to prolong to the utmost the useful life of tires now on the road. These tires constitute the Nation's principal stockpile and represent our greatest safeguard against collapse of our transportation system.

The analysis made by the Baruch Committee of the rubber supply on hand indicates there is sufficient for the civilian to maintain an average of 5,000 miles per year. This fact, however, does not mean that the civilian should drive 5,000 miles a year if he can transact his essential business by driving less.

Individual sacrifices should and must be made. They are merely one of the contributions every citizen must make to the war effort and are comparatively small when compared with those the men of our armed forces are making.

Riverside Has New Divided Highway

(Continued from page 14)

of the curb lines, thus preserving the striking appearance of the palm-bordered approach to Riverside.

TREES LEFT IN PLACE

Along frontages of the University of California Citrus Experimental grounds two rows of large pepper trees that bordered the old road were left in place, one row falling in the space utilized for the separation strip between north bound and south bound traffic lanes. At the intersection with Iowa Avenue, and with Pennsylvania Avenue free turning lanes were provided to facilitate traffic flow.

The centrally located contract was about 1.5 miles in length with its northerly terminus at the railroad overhead crossing. It included widening the railroad overhead structure from a two-lane to a four-lane section with a four-foot division curb between the two inside lanes; constructing a roadway separation structure; constructing a graded two-lane roadway adjacent to the existing road with an intervening separation space, and placing imported borrow, cement treated base and plant-mixed surfacing.

On the southerly contract, continuing from the central one and extending to about five miles north of Perris, the four-lane divided highway section was constructed with a 30 to 79-foot separating space between inside traffic lanes. On this portion also a cement treated base was placed over a blanketing layer of imported material, and was topped with plant-mixed surfacing.

BASE MATERIAL

Cement treated base material was mixed in the contractor's mixing plant, set up at the aggregate pit site. Graded aggregate was mixed with 7 per cent of cement and from 8.5 per cent to 10.0 per cent of water and hauled to the job in dump trucks. It was spread on the street by two self-propelled, mechanical spreading and finishing machines which pushed the trucks immediately ahead of them while the trucks were discharging the mixture, to keep an even supply passing through the machines.

The partially compacted base material was then rolled with a three-axle roller weighing about 14 tons. The rolled surface was kept moist by a mist-spray until covered with a curing seal of asphaltic emulsion, applied at the approximate rate of one-sixth gallon per square yard.

Plant-mixed surfacing, in which the mineral aggregate was mixed with paving asphalt, 150-200 penetration, was placed over the cement treated base to a thickness of three inches. The surfacing was laid in two courses of 1½ inch each and was shaped and compacted using motor powered graders and pneumatic tired rollers. A heavy three-axle roller was used for final rolling.

ENGINEERS' PROBLEMS

While the plans were being drafted for these three units and during the time that construction operations were under way, "priority control of critical materials" introduced many new problems for the engineers.

Some 10,000 lineal feet of concrete pipe was used in the drainage system. Although the concrete pipe required some steel for reinforcement, the amount was small compared to the approximate 300,000 pounds of steel that would have been required if metal culvert pipes had been used.

Gravity type headwalls were constructed and unreinforced concrete drop inlets were used with timber covers. A lighting system was omitted also to save critical materials.

Considering the three construction units as one major project, the result is a four-lane divided highway 10.3 miles in length of which 3.84 miles is paved with Portland cement concrete and the balance with plant-mixed surfacing placed over cement treated base.

CONGESTION RELIEVED

At the intersection of U. S. 395 and U. S. 60 near Box Springs Station a grade separation structure was constructed to pass the east bound traffic on U. S. 60 under the north bound traffic on U. S. 395. All other traffic movements around this intersection were isolated to definite channels designed to obtain a minimum of interruption to traffic. Islands between traffic channels were constructed of plant-mixed bars, painted white, to form a physical barrier in these areas.

Acute traffic congestion was in evidence on the old two-lane road. After opening the new four-lane divided section to traffic, congestion was completely alleviated.

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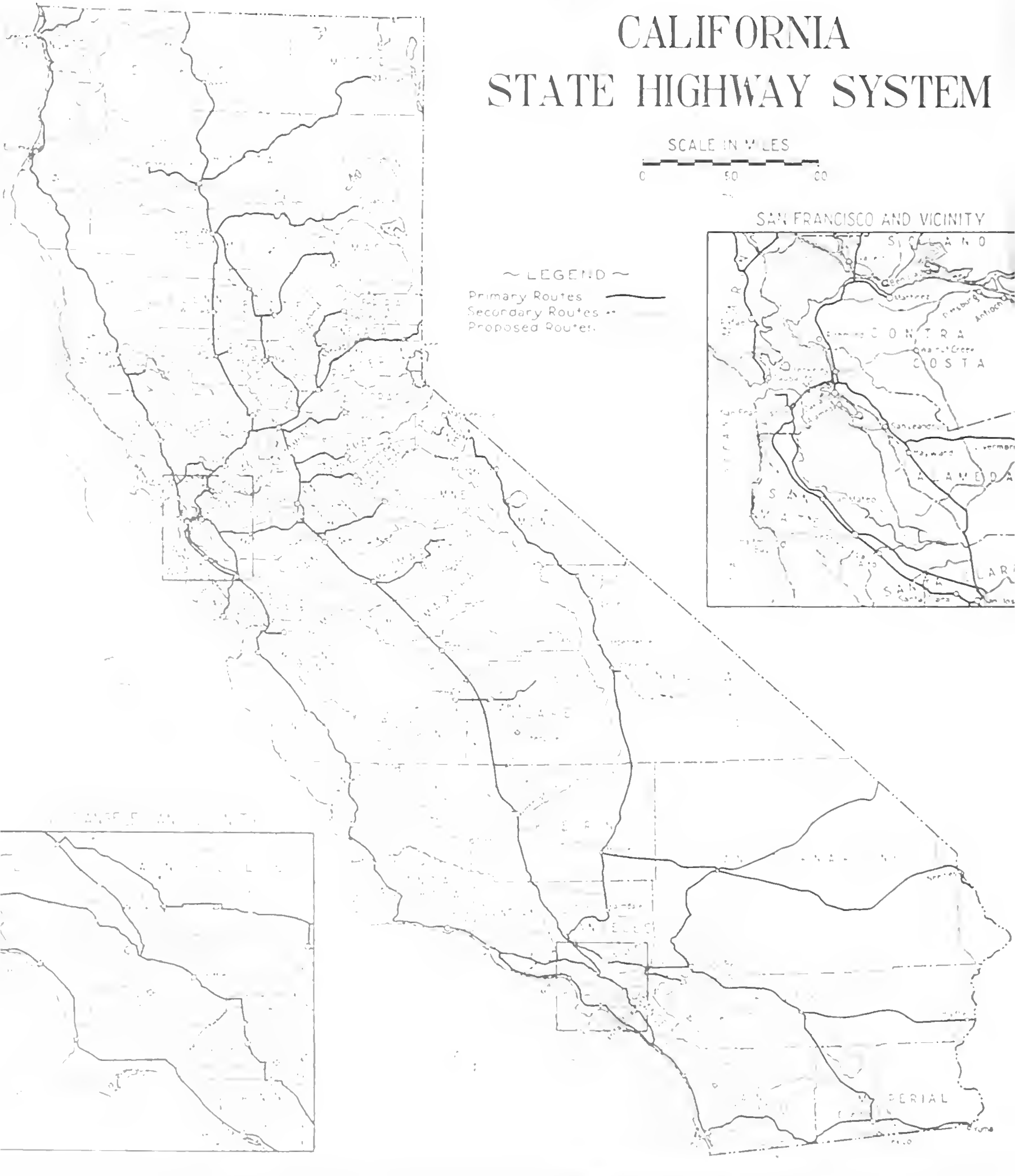

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CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California [PRINTED IN U.S.A.]

FRANK W. CLARK, Director   C. H. PURCELL, State Highway Engineer   J. W. HOWE, Editor   K. C. ADAMS, Associate Editor

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$29,425,000 Decrease Estimated in Highway Funds of Next Biennium Due To Rationing and Loss of Federal Aid

DUE to tire and gasoline rationing and the loss of Federal aid funds, California in the next biennial period may be confronted with a shrinkage in State highway revenues approximating as high as 60 per cent, State Highway Engineer C. H. Purcell has informed the California Highway Commission.

Purcell submitted to the Commission an estimate of income for the 95th-96th fiscal years which is $29,425,000 less than the amount in the present budget.

From the indicated decline in traffic and with the benefit of the experience of gas rationing in eastern States, Purcell estimated that within a few months, the now rapidly declining gas tax revenue will be less than last year's by 35 to 50 per cent. The accuracy of these estimates was confirmed by the fact that the October, 1942, gas tax apportionment, which had been predicted would be 15 per cent less than that of October, 1941, amounted to 15.8 per cent less.

Allocation of Highway Funds Recommended

The following recommendations for distribution of the 95th-96th fiscal years highway funds were made to the Highway Commission by State Highway Engineer C. H. Purcell:

Estimated Revenues			
1. Gas Tax		$45,134,000	
2. Motor Vehicle Fees		7,400,000	
3. Use Fuel Tax (Diesel)		2,066,000	
4. Caravan Fees		100,000	
5. Federal Aid		0	
Total			$54,700,000
Allocation			
1. Administration		$3,934,250	
2. Traffic Engineering and Special Investigations		330,000	
3. Maintenance		19,104,000	
General	$19,054,000		
Carquinez & Antioch Bridges	50,000		
4. Highway Planning Survey		200,000	
5. Major City Streets—¼¢ gas tax allocation		5,641,750	
6. City ¼¢ for State Highways		5,641,750	
7. All other functions (Reconditioning, resurfacing, improvement, engineering, right of way, joint highway districts, reserve and contingency)		19,848,250	
			$54,700,000*

* Less deduction of $11,283,500 representing ½¢ gas tax allocations to cities.

Purcell estimated that the Division of Highways will have for expenditure on State highways outside of incorporated cities the sum of $43,416,500 as compared to $72,841,500 for the same purposes provided for in the current biennial budget.

ESTIMATED REVENUES

Estimated revenues for the next biennium, Purcell reported, will be approximately $54,700,000. Subtracting $5,641,750 of ¼-cent gas tax allocations for major city streets and a like sum for State highways within cities, a total of $11,283,500, will leave $43,416,500 for expenditure by the Division of Highways for administration, construction, maintenance, and all other functions.

During the next biennium the State will be deprived of normal Federal aid funds as represented in the present budget of $7,960,000 of Federal aid, $460,000 for feeder roads and $997,000 for strategic highways.

Purcell pointed out that no large State highway projects can be planned for construction due to restrictions imposed by the Federal Government which prohibit highway construction that is not directly essential to the war effort and which require approval of the Army and the Public Roads Administration for all jobs costing in excess of $1,000. He said that the State will have to confine itself almost entirely to maintenance work and reconditioning of highways damaged by excessive traffic due to war activities.

TRAFFIC COUNTS DECREASE

In a statement Purcell said: "While for the past months and at the present time, the California Division of Highways has been engaged in the enormous construction program for access and defense roads financed almost entirely with Federal funds, the rubber shortage, speed limitation and imminent rationing of gasoline have lessened highway traffic to the point where revenue from the gas tax is definitely on the decrease.

"Traffic counts on the State Highway System for July, 1942, when compared to those of July, 1941, showed an average decrease in total traffic volume of 17.7 per cent with a maximum of 55 per cent decrease recorded on one interstate route.

"At the same time there have been general traffic increases on certain arterials which feed areas of concen-

(Continued on page 9)

Fill slope treatment. Half of seed is sowed before straw is applied

A closer view of strawing operation. Rate of application is 3 tons per acre

Vegetative Slope Protection on Access Road Cuts and Fills

By L. S. MANNING, Asst. Resident Engineer

THE principles of vegetative protection of highway cut and fill slopes, as outlined in an article by H. D. Bowers in the May, 1942, issue of "California Highways and Public Works" magazine are being applied to seven military access road contracts now underway or recently completed in Monterey County, District V, Division of Highways.

Due to the fact that very little data is available regarding the cost of slope erosion control, an attempt has been made in District V to coordinate this work in relation to other contract operations and to determine the most effective methods to use. Specifications covering the various contracts differed slightly as to the basis of compensation to the Contractor.

TOPSOIL STRIPPED

All specifications contained the provision that slopes be left in a roughened condition with an allowable variation from the plans of not more than one-half foot.

Wherever preliminary investigation disclosed a likelihood of erosion, topsoil was stripped and stockpiled. This was later spread on slopes to a depth of from three to four inches and was then seeded with western rye grass at the rate of one pound per 300 square feet.

Straw was then applied at the rate of three tons per acre and punched into the soil with shovel. Commercial fertilizer was spread on those cut slopes where, in the judgment of the Engineer, the available topsoil was not sufficiently fertile to support good plant growth.

Fill slope treatment consisted of seeding and applying straw to new fill slopes on three contracts near Castroville. Bid prices for this work were \$0.06, \$0.08 and \$0.10 per square yard, however, actual cost proved to be only about \$0.03 per square yard for the operation.

PRICE-COST DIFFERENCES

On two contracts, topsoil was stripped, stockpiled, cut slopes roughened and topsoil spread over the slopes; compensation being on the basis of roadway excavation. Slope erosion protection on these contracts consisted only of seeding and applying straw. Bid prices were \$0.08 and \$0.10 per square yard, while actual costs were comparable to fill slope treatment at about \$0.03 per square yard.

On five other contracts an erosion protection item provided for the roughening of cut slopes, the removal of topsoil from stockpiles, drifting topsoil over slopes, the seeding and application of straw. Stripping and stockpiling of topsoil was paid for as roadway excavation.

Bid prices on the Erosion Protection Item were \$0.12, \$0.15, \$0.20 and \$0.30 per square yard. Actual costs, however, have been from \$0.07 to \$0.09 per square yard depending on the amount of hand work required in roughening cut slopes.

Topsoil was imported at those locations where local material was not sufficient to cover the slopes. Bid prices were \$0.70 and \$1.50 per cubic yard, including the loading, hauling, and spreading. Actual costs of this operation are not as yet available. On one contract, where a considerable amount of fill treatment excavation was necessary, the dredged material, rich in humus, was used as topsoil on the thorough-fill slopes and at other locations where the topsoil was insufficient. By this procedure, both of the problems relating to disposal of dredged material and obtaining topsoil for fill slopes were solved.

METHOD PROCEDURE

In general, the following methods were used:

As excavation progressed, topsoil sufficient to cover the slopes was stockpiled in windrows well away from construction operations. This was accomplished by the use of a motor grader or bulldozer. Small benches parallel to the roadbed were left in the cut slopes by grading equipment, thus providing a roughened surface upon which to place the topsoil.

After oil mix gutters were completed, the top of slopes were rounded, and topsoil removed from windrows by motor grader. This material was then drifted down over the face of the cuts. Hand labor was principally used to rake the soil and complete the cover, although one contractor resorted to a long plank pulled by chains from above and below to move the bulk of topsoil farther down the slope. This resulted in a substantial reduction in labor costs.

Compacted surfaces left by slope rounding operation were loosened with a scarifier, thus preparing the soil for seeding. Slough, which rolled to the gutter during the placement of topsoil was picked up by hand and hauled away.

STRAW WAS ANCHORED

Bales of straw were placed at the top of slopes, broken up, and passed to a line of men who spread it evenly over the slope area. A second line of men punched or tucked the straw into the loose topsoil with shovels at approximately one foot intervals, the object being to anchor the straw and tie the uncompacted topsoil together. Half of the allotted quantity of seed was sowed before the straw was applied, after which the remainder was placed, in order to insure an even stand of grass.

On all contracts, those areas outside of cut and fill slopes which were subject to erosion were seeded with western rye grass or barley and paid for as extra work. Seed was covered by hand or horse drawn cultivation. Since these projects will be completed during the coming rainy season, it was highly desirable to obtain a quick protective cover, this was accomplished by the application of commercial fertilizer where necessary.

SOIL LOSSES CONTROLLED

From observations made in District V on experimental plots near Santa Barbara and work on contracts in Monterey County, it is evident that certain modifications in technique may be made, resulting in a lessening of cost to the State for erosion control.

It has been found that a cover of vegetation offers the most practical means of controlling soil losses from highway cut and fill slopes, and that a blanket of topsoil is necessary for the establishment of an effective growth of vegetation. All slopes composed of material which may erode, therefore, should be designed for topsoil cover with provisions for a generous amount to be stripped and stockpiled before excavation. Any excess may generally be used for forming intercepting ditch, berms, or in the development of transitions at the ends of slopes.

The adequate roughening of cut slopes composed of compacted, or highly impervious material is most important in order to break up the slippage plane which otherwise would exist, resulting in loss of the topsoil layer during winter rains. The excavation of small benches from 4 to 6 inches in depth at intervals of one foot during the progress of construction is a relatively easy matter to accomplish by the use of a bulldozer or blade.

TOPSOIL APPLICATION

Topsoil should be applied on cut slopes when excavation is approximately one foot above profile grade. At this stage, equipment can be freely used for spreading operations on the slopes, and resulting slough may be disposed of by excavation equipment. Straw should then be applied. This procedure has several distinct advantages, chief among these being that when a project is under construction during the winter or spring months, protection is given to the slopes as soon as they are exposed.

Quite often a growth of vegetation may be obtained a year earlier than if this work were done at a later stage in construction. If application of topsoil is made after the gutter is in, costs are considerably increased due to the necessity for a larger propor-

(Continued on page 20)

Raking top soil down—Improved appearance of cuts after covering would justify this method if no other factors were involved

Raking top soil down unconsolidated sand cut. Tendency toward erosion by wind action already apparent

Culvert Entrances and Headwalls On California Highway System

ROBERT L. THOMAS, Assistant Engineer—Surveys and Plans
GEORGE A. TILTON, Jr., Assistant Construction Engineer

Foreword

This is the fourth of a series of 10 articles in this magazine based on a joint departmental review of culvert practice of the California Division of Highways, by a committee composed of R. Robinson Rowe, Assistant Engineer, Bridge Department, Clarence F. Woodin, Assistant Maintenance Engineer, and the writers. Following a preliminary outline in the August issue, the series has included: September issue—"Comparative Hydrology Pertinent to California Culvert Practice"; October issue—"Debris Control at Culvert Entrances on California Highways;" November issue—"Highway Culvert Location and Slope from a Review of California Practice."

The series continues with a consideration of entrance conditions involving headwalls and endwalls and appurtenances and their effect on hydraulic efficiency of the culvert.

FOR the past 30 years of California culvert practice, empirical determination of the size of a culvert opening has been the all-important essential of design. The ability of a culvert to carry drainage water under the highway has been based on the size of entrance opening with too little attention to other hydraulic and installation refinements. This practice, however, has been more or less justified by the fact that run-off records were few and short, so that floods could not be estimated closely. Under such conditions there was little logic in resorting to refinements in hydraulic design.

This practice was no doubt widespread and recognized as such at the time of experiments on the flow of water through culverts in 1926. (1)* It was pointed out that nearly 30 different formulas had been proposed for use in determining the run-off and waterways required for culverts. In practically all of these formulas the area of the waterway is given directly without apparent consideration of the hydraulic gradient, coefficient of roughness or the form of the entrance.

Recognition of the above situation in California has stimulated special designs in the past few years. Inspection and inquiry throughout the State concerning these experimental designs including rounded-lip, belled-lip entrances or transition throats brought out little enlightening data on their performance, probably due to difficulty of inspection at the time of maximum flow.

With accumulation of longer-period rainfall records by various governmental agencies enabling increasingly accurate determination of the intensity-frequency of run-off and availability of experimental hydraulic culvert data, the time has arrived for adopting design refinements. The proper place to begin these refinements of the culvert proper is at the entrance.

Rounding, beveling or expanding the entrance in almost any way will increase capacity of the culvert for every design condition—whether outlet is free or submerged; whether slope is above or below critical; whether 10-year flood just fills the entrance (unbalanced design) or the 100-year flood fills the pipe throughout with head at entrance (balanced design).

Under conditions of balanced design and given quantity, the rounded-lip entrance will maintain the same mean velocity at lesser head, the effect of which is to equalize velocity distribution within the section by accelerating the current along the wetted perimeter and reducing concentration at center, thus abating the scour effect at outlet.

Rounded-lip and Beveled-lip Entrances

Efficiency of expanded entrances increases with the culvert size and

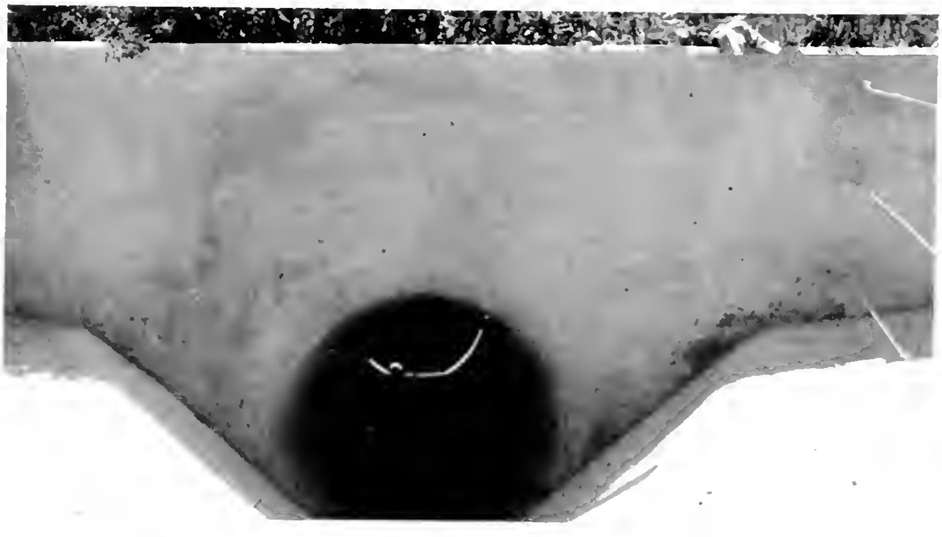

FIG. 17. Concrete pipe with rounded-lip entrance. Note "drop-down" apron to accelerate flow before reaching culvert entrance

* Numbers in parenthesis with asterisk refer to bibliography listed at the end of this article.

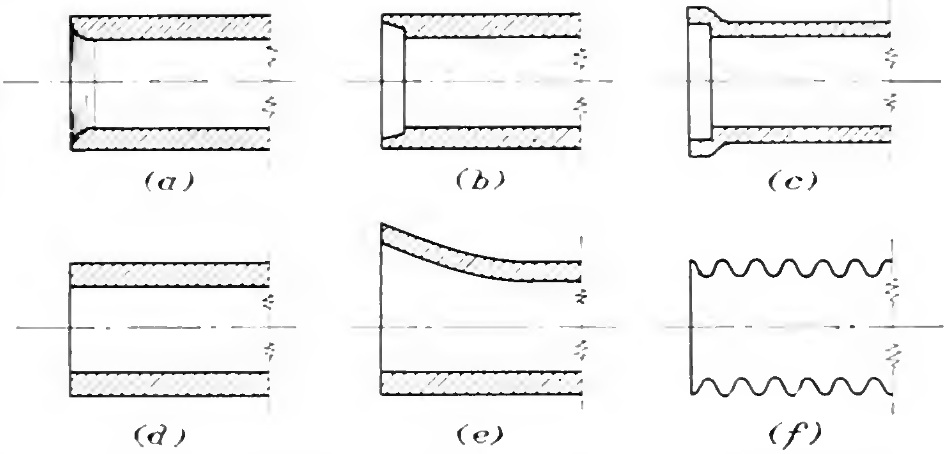

FIG. 18. (a, b, c, d, e, f) Types of Culvert Entrances. (a) Rounded-lip (concrete), (b) Beveled-lip (concrete pipe), (c) Belled-lip (concrete or vitrified pipe), (d) Square-ended (concrete), (e) Belled or throated (concrete), (f) Affected rounded-lip (corrugated metal)

FIG. 19. Rounded-lip entrance to concrete box culvert

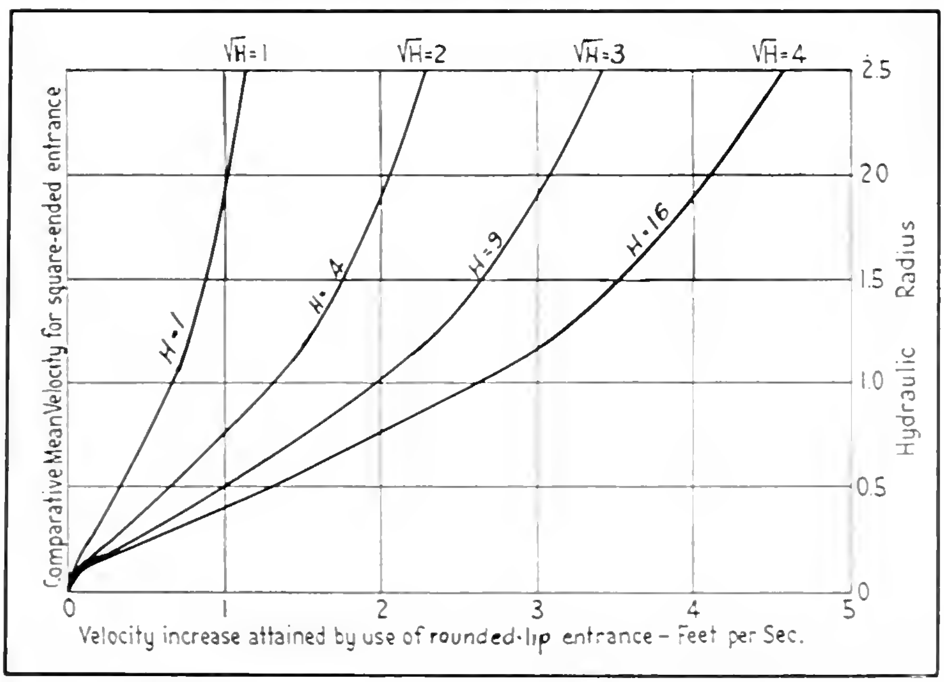

FIG. 21. Increase in velocity attained by a rounded-lip entrance compared to a square-ended entrance. (For culvert 100 feet in length.)

decreases with the culvert length. (See Fig. 18.)

For example, a 39-inch beveled-lip concrete pipe 30 feet long has the same capacity as a 42-inch square-ended concrete pipe; likewise, a 57-inch beveled-lip is equivalent to a 63-inch square-ended pipe. On the other hand, a 51-inch beveled-lip concrete pipe 200 feet long is just equal in capacity to a 54-inch square-ended pipe. Fig. 17 shows a concrete pipe with a rounded-lip which is not recommended—the commercial beveled-lip is considered to be satisfactory.

The saving in entrance loss for concrete pipes is shown briefly in Table 2 in which "E" represents the percentage of total head lost in beveled-lip pipe to that lost in a square-ended pipe of the same diameter. In other words "E" is the efficiency of the square-ended pipe relative to the beveled-lip pipe.

TABLE 2

Diameter Concrete Pipe	"E" Culvert Length 30′	100′	200′
18″	85	91	94
48″	71	75	80
72″	64	68	72

The same principle affects concrete box culverts to a greater degree, because the entrance can be rounded to the optimum shape (Fig. 19) whereas it is not practical to require a special rounding of a commercial pipe. Fig. 21 graphically illustrates the velocity increase due to rounding of entrances as compared to square-ended entrance. When the water surface at entrance is below the crown of the culvert, the condition approaches that of a weir and the increase in velocity by use of a rounded-lip is between 5 per cent and 6 per cent.

Hydraulics Affecting Culvert Entrances

The head required for a culvert has at least four components: (1) Velocity head, (2) Entrance loss, (3) Friction loss, (4) Eddy loss.

The first two are effective at the entrance, unless the culvert becomes a siphon. (Siphons and sag-pipe culverts will be treated in a later article.) The elevation of the headwater pool above the crown of the culvert cannot be reduced below their sum. Hence, any saving in entrance loss will be reflected ordinarily in a lowering of headwater pool, which means a decrease in backwater above the culvert.

Experiment (1)* has determined that this saving is independent of culvert length and is proportional to the velocity head, in accordance with the following formulae:

(For concrete pipe culvert) $\blacktriangle h_e = (.31\sqrt{D} - 0.10) h_v$

10

(For box culvert) $\blacktriangle h_e = (.4\sqrt{R^3} - 0.05) h_v$

Table 3 gives values for these expressions for several sizes of culverts and three entrance velocities.

Table 3

Culvert Size and Type	Saving in Entrance Loss (head in feet) by Beveled-lip or Rounded-lip over Square-ended Entrance for Velocity of 5	10	15
18" concrete pipe	.11	.44	.98
48" concrete pipe	.20	.81	1.82
72" concrete pipe	.26	1.03	2.31
2'x1.5' concrete box	.10	.40	.91
4'x3' concrete box	.13	.52	1.16
8'x6' concrete box	.16	.65	1.47
12'x9' concrete box	.19	.75	1.68

Since use of beveled-lip entrances on concrete pipe or rounded-lip entrances on concrete box culverts will either: (a) Reduce the size of culvert, or (b) reduce materially the back-water caused by the culvert, the Committee recommends:

(1) That beveled-lip entrances be adopted as standard practice for concrete pipe and rounded-lip entrances for concrete box culverts, with a radius of rounding equal to approximately 10 per cent of the greatest culvert dimension; and that square-ended entrances be considered as exceptions which need to be justified for either type of culvert.

In the case of arch culverts, whether part-circle, multiple, or concrete, rounding of the vertical entrance walls only is recommended. The cost of forming a rounded-lip on the crown portion of a concrete arch will offset any saving in head.

Rounding of the concrete headwall to corrugated metal culverts is not recommended since the manufactured product already affects a rounded-entrance.

Throated Culvert Entrances

In special cases where it becomes economical or practical to reduce the culvert section, as in the case of a very long culvert, throated-entrances are justifiable (Fig. 20). To offset the conjectural objection to the throated entrances to culverts in waterways carrying heavy debris, some type of debris control* should be installed to prevent large stumps

FIG. 20. Forms for throated entrance to concrete arch culvert. Note gradual flattening of grade towards outlet

from entering and choking the throat.

CULVERT HEADWALLS AND ENDWALLS. See Fig. 25

Widespread field inspection indicates an arbitrary and nonuniform practice in the selection and adaptation of headwalls and endwalls. The tendency towards selection of the same standardized type for both the headwall on the upstream end and

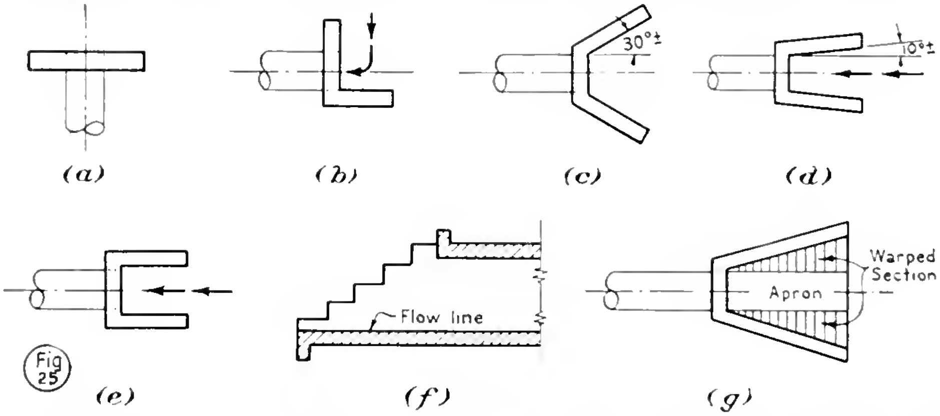

FIG. 25. (a, b, c, d, e, f, g) Types of Endwalls and Headwalls. (a) Straight headwall or endwall, (b) "L" headwall, (c) Wing headwall or wing endwall (30°± flare), (d) Flared headwall (10°± flare), (e) "U" type headwall or endwall, (f) Stepped "U" type headwall or endwall, (g) Warped wingwall or endwall

FIG. 22. Warped wing headwall with rounded-lip crown at entrance to concrete box culvert

* See October 1942 Issue California Highways and Public Works.

FIG. 24. Stepped "U" Type Endwall. Most inefficient type—not recommended except for cattlepass where drainage is a minor factor

the endwall on the downstream end in disregard of the different stream flow conditions is evident.

At culvert entrances, wingwalls are frequently given an arbitrary flare of 45 degrees, which generally proves unsatisfactory for high approach velocities or oblique approach flow. Flaring wingwalls from the axes of the approaching stream flow instead of from the culvert axis, is advisable. Warped wing headwalls (Fig. 22) costing little more than vertical wingwalls reduce scour as well as loss of head at the culvert entrance.

When combined with an apron on a drop-down slope from the approach channel, an increase in velocity is induced by the contracting water section such as to materially increase efficiency of the culvert entrance. (Fig. 17.) At the outlet, wing endwalls are often flared to lines that water can not follow at high velocities. This results in scour of embankments from eddy action at the ends of the wingwalls each side of high velocity effluent.

Increased culvert efficiency may be obtained by proper attention to the design and selection of headwalls and endwalls as indicated in the following observations in recent experiments (1)* as follows:

"The 45 degree wingwalls used in connection with a corrugated metal pipe culvert increase the capacity from 1 to 10 per cent over that obtained in a metal pipe culvert with a straight endwall."

FIG. 26. Open lined training channel to concrete box culvert accelerating stream flow requiring minimum culvert section. Note warped wings

"The 45 degree wingwalls used in connection with a corrugated metal pipe culvert are more efficient when set flush with the edge of the pipe than when set 6 inches back from the edge of the pipe."

"The 45 degree wingwalls used in connection with a corrugated metal pipe culvert are more efficient when built full height to the top of the headwall than when constructed only to the standard height." (Crown of entrance)

"The 'U' type wingwalls used in connection with a vitrified clay pipe culvert produce a carrying capacity slightly less than that with the straight endwall." (headwall)

RECOMMENDED ADAPTATION OF HEADWALLS AND ENDWALLS

Straight Headwall

For low approach velocity or headpool, light floating debris, undefined approach channel; or small defined channel entering culvert without change of direction; or limited right of way, or small culvert near grade.

Straight Endwall

For low velocity effluent not requiring outlet protection against eddy action.

"L" Headwall

For gutter drainage (traverse relief culvert) where necessary to abruptly change course of water, natural defined channel where abrupt change of line cannot be avoided.

Wing Headwall or Wing Endwall

For well-defined channel, moderate velocity, medium drift.

Warped Wing Headwall (Fig. 22)

For well-defined channel, moderate to high approach flow, medium drift, is considered the most efficient type of practical headwall, streamlining flow by a gradual transition from the wider channel, higher stage and slower velocity of channel flow to a higher velocity at culvert entrance—particularly effective with drop-down apron to accelerate and contract stream flow before it reaches culvert entrance.

Warped Wing Endwall

For moderate to high velocity discharge, is considered the most effi-

* Numbers in parentheses with asterisk refer to bibliography listed at the end of this article.

cient type of endwall at outlet because it reduces the drop down curve (free outlet) and minimizes velocity at the end of the apron.

"U" Headwalls and "U" Endwalls Stepped "U" Headwalls and "U" Endwalls

Most inefficient type of headwall or endwall, insofar as hydraulic considerations are concerned. (1)* Advantage lies in ease and economy of extension. (Fig. 24.)

Recommended only for cattle passes where drainage is a minor factor.

Flared Headwall

For well defined channel with moderate approach velocity, medium drift, at high velocity, and heavy drift at moderate velocity.

Advantage lies in ability of slightly flared walls to align drift so that it passes the culvert endwise.

No Endwall

Endwalls are not required at the downstream end of pipe culverts where there is little likelihood of damage from erosion. Cantilever extension of metal pipe are generally cheaper than endwalls. Experiments (1)* indicate that a headwall at the upstream end of a culvert increases entrance efficiency over a culvert with no headwall.

Miter and Skew End-Cuts For Metal Pipe and Multiplate Culvert

Where culverts are laid oblique to the roadway alignment, miter and skew end-cuts for the sole purpose of fitting embankment slopes or paralleling the roadway centerline are not recommended. (Fig. 28.) Uncut projections are not generally unsightly (Fig. 27). Miter cuts make future extensions expensive, saving in cost is negligible, representing little more than scrap value of cut-off; structurally the pipe may be weakened unless mitered end is adequately reinforced with rods. The Committee found no support for the practice of miter or skew cuts.

FIG. 27. Multiplate culvert endwall without miter or skew cut—recommended practice

FIG. 28. Entrance to multiplate culvert with skew and miter cut. Committee finds no general justification for either skew or miter cuts for metal pipe or multiplate culvert

Summarizing its findings the Committee recommends generally that:

(1) The practice of referring to headwalls and endwalls separately be encouraged in place of the general term of "headwalls" for both upsteam and downstream ends.

(2) That headwalls be designed to obtain efficient transition of high velocity flows from natural stream channels to culvert entrances by use of warped wingwalls.

(3) That wing walls be flared by protraction from the stream axis instead of the culvert axis.

(4) That miter or skew cuts of metal pipe or multiplate culverts be justified by other reasons than cost.

(5) That the practice of placing headwalls and endwalls parallel to the highway alignment for the sole reason of appearance be discouraged and that exceptions be justified.

(6) That the use of lined open training channels and drop-down aprons be encouraged at culvert entrances for the purpose of accelerating approach flow requiring smaller culvert sections (Fig. 26).

* Numbers in parenthesis with asterisk refer to bibliography listed at the end of this article.

Bibliography

(1) Flow of water through culverts. (Bulletin 1, University of Iowa, Studies on Engineering, 1926)

City miss (to farmer)—"Why are you running that sharp harrow over the grain field? Are you going to raise shredded wheat?"

$29,425,000 Decrease Estimated in Highway Funds of Next Biennium

(Continued from page 1)

trated industrial activity. One such arterial showed an increase of 14 per cent over a year ago, with the months of April, May and June showing increases of 9 per cent over the first three months of the year. On this route there was an increase in the number of buses from 7,000 in January to over 11,000 in June and in trucks from 24,200 in January to 27,500 in June. On another industrial arterial serving large plants the July, 1942, count was 18 per cent above the July, 1941, count.

"These localized increases, however, are not sufficient to offset the general decline in travel and the corresponding reduction in revenue from the gasoline tax.

CURTAIL MAJOR PROJECTS

"On the basis of the estimated reduction in gas tax revenue, it has been determined that a reduction of $6,500,000 in major projects included in the current budget will be necessary to balance the budget between now and June 30, 1943. This reduction will be accomplished by deferring projects disapproved by the War Production Board as not essential to the progress of the war.

"It must, of course, be understood that elimination of these projects does not mean that the work will be forgotten but that it is merely deferred by the exigencies of the emergency.

"The principal program will be one of maintenance and holding what we have by resurfacing and reconditioning highway surfaces with bituminous blankets and bridge preservation. It is anticipated that if roads essential to the war are to remain in a serviceable condition, resurfacing on some 800 miles at an estimated cost of approximately $7,500,000 must be accomplished as soon as possible.

"General maintenance will be drastically reduced on nearly 2,800 miles of the State Highway System so that essential roads may be kept in service with the limited revenue available. With the practical elimination of the reconstruction program and the concentration of maintenance upon military roads, there is a possibility that the deterioration of considerable portions of the 13,800 miles in the State system will be such that it might require an increase in statutory maintenance limitations to repair the damage resulting from the lack of proper maintenance. It is our aim to pass through the present period with no change in the law which limits maintenance expenditures. The probable highway deterioration will, however, present a most serious handicap after the war when the State will be confronted with the necessity of a large construction program during the readjustment period.

"The problem confronting the Division of Highways is the most serious in California road history and resolves itself into four principal factors: inadequate finances, lack of equipment and materials, and greatly reduced man-power. Solution of this four-fold problem will be accomplished to the best of our ability, with the one idea always in mind that serving the war effort is of first importance and by adoption of a four-fold policy of operation during the emergency. This policy will include: first, maintenance and reconditioning of highway surfaces in serviceable conditions; second, upkeep of bridge structures to present standards; third, preparation of plans for needed highway construction during the period of adjustment after the war; and lastly, insuring the integrity of highway development already begun by acquisition of adequate rights of way for the planned improvements.

The Federal Public Roads Administration has been and continues to be of real service to the Division of Highways in securing the assignment of ratings and it is felt that conditions will improve as the War Production Board comes to an understanding of the relationship of all phases of the work.

Division Recommended for North and South

Recommended distribution by Highway Commission of 95th-96th Fiscal Years State Highway Funds between North and South is as follows:

Allocation of (6) All Other Functions

1. Primary North 54.24% of 50%	$6,912,888	
2. Primary South 45.76% of 50%	5,832,112	
Total PRIMARY		$12,745,000
3. Secondary North 50% of 50%	$6,372,500	
4. Secondary South 50% of 50%	6,372,500	
Total SECONDARY		$12,745,000
Grand Total		$25,490,000
1. Primary NORTH	$6,912,888	
3. Secondary NORTH	6,372,500	
Total NORTH		$13,285,388
2. Primary SOUTH	$5,832,112	
4. Secondary SOUTH	6,372,500	
Total SOUTH		$12,204,612
Grand Total		$25,490,000

Construction Decline in 1943

A decline of one-third in the volume of construction in 1943 was forecast by Stacy May, Director of Statistics Division, War Production Board. This estimate was revealed to the American Institute of Steel Construction in a telegram.

"It is expected that the volume of [illegible] building construction, exclusive of ship building, scheduled for the War Program in 1943 will drop [illegible] one-third.

"Because of this reduction of volume and because of the use of methods which economize steel, it is expected that the volume of fabricated structural steel which will be required for building and engineering construction, exclusive of ship building in 1943, is substantially less than was had this year, and will amount to [illegible] quarter tons."

Report on Highway Maintenance Equipment and Rental Procedure

By T. H. DENNIS, Maintenance Engineer

The following article is the first installment of a condensed report of the Sub-Committee on Highway Maintenance Equipment appointed by the Highway Research Board in 1940 to make a specific study of various types of equipment available or in use in performing highway maintenance work with a view to recommending the most suitable and practicable equipment for specific maintenance operations and the establishment of uniform equipment rental procedure throughout the United States. The report represents two years' work by the sub-committee members, T. H. Dennis, Chairman; A. A. Anderson, Portland Cement Association; H. K. Bishop, Chief of Construction, Public Roads Administration; B. E. Gray, Chief Engineer, Asphalt Institute; J. E. Lawrence, State Highway Maintenance Engineer, Massachusetts; Rex M. Whitton, State Highway Maintenance Engineer, Missouri, and was presented at the recent convention of the Board at Detroit. The pictures shown illustrate type of equipment only and the type is not restricted to any particular product.

TO facilitate the study and permit the placing of each piece of equipment under its proper function the subject of highway maintenance was divided into eight major categories as follows:

1. Maintenance of traveled way
2. Maintenance of shoulders
3. Maintenance of roadsides
4. Maintenance of bridges
5. Maintenance of miscellaneous structures
6. Snow removal, drift and ice control
7. Maintenance of trees, shrubbery and plantings
8. Maintenance of safety devices

This outline was submitted to all State Highway Departments, the Public Roads Administration, the Asphalt Institute and the Portland Cement Association, a total of 62 organizations.

Response from the various organizations contacted was very good. Reports of equipment used in maintenance work were received from 31 States and from all 12 Public Roads Administration Districts. The information submitted was not complete in all cases but was representative and reflected a majority practice.

It was expected that the varied climatic conditions encountered throughout the United States would develop special requirements in maintenance and thereby produce special features in the equipment used. Hence the States, as well as the various Public Roads Administration Districts were grouped by [illegible] climatic conditions to permit summarization of the data on that basis.

Equipment Rental

FORTY-ONE States responded to a questionnaire on equipment rental which was submitted to them by the Highway Research Board. The majority opinion of the reporting agencies generally reflected the subcommittee's opinion. The replies, however, definitely argued against the possibility of any general acceptance of a uniform rental system. A summary of the replies to each of the items included in the questionnaire and the subcommittee's recommendations follow:

Item 1. (A) Is the present method of handling equipment satisfactory?

(B) Are any changes contemplated in the present system?

The majority of States reporting considered present methods of handling equipment satisfactory and none contemplated changing present methods. It would thus appear that promotion of a uniform rental system will be difficult.

Item 2. Does the State Highway Department perform all maintenance work on State Highways, or is all or a portion let to contract to other political subdivisions or private contractors?

(Continued on next page)

Basis of Selection

Upon receipt of data from the various organizations, every piece of equipment used by them was listed in its proper category on tabulation sheets. The equipment as recommended by each of the subcommittee members for each maintenance operation was also entered on the tabulation and their recommendation was considered equal to that of any State or Public Roads Administration District.

Obviously all of the recommendations received did not merit consideration for inclusion in the final tabulation. It was agreed, therefore, that a choice of approximately 10 per cent of the reporting agencies would be required to qualify a unit for inclusion in the final recommendation. Under this procedure the recommendation of any five of the reporting agencies was taken as the minimum requirement for the selection of a particular unit.

This method obviously eliminated certain special nonstandard or obsolete types which some organizations found it expedient or necessary to use under their particular local conditions.

The equipment selected for any specific type of work, therefore, represented the majority recommendation of the reporting agencies. In general the recommendations were remarkably consistent, the principal variance being in size or capacity.

A study of the principal types reported indicates the following general trend as to use and also the scope of work for which the unit is particularly suited.

Discs

The light disc harrow and scarifier is used to some extent in certain areas in the construction and maintenance of intermediate oil type surfaces. This limited use is due either to a preponderance of high type surface or the employment of mixing plants. The scarifier attachment on motor graders and tow graders is responsible for the declining use of the separate unit. The motor grader disc attachment is adaptable for removing irregularities on bituminous type surfaces.

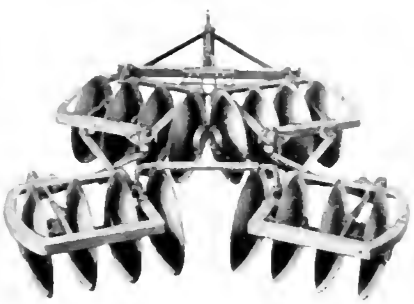

FIGURE 1

The light disc harrow should be of the offset type with heat treated discs and each disc equipped with a scraper and positive pressure type lubrication fittings. The frame should be adjustable so that the gangs may be operated at opposing angles. A short coupled tractor hitch should be provided.

The weight of harrow should not be less than 2,000 pounds and the width approximately 8 feet. The discs should be from 18 inches to 24 inches in diameter spaced on about 10-inch centers.

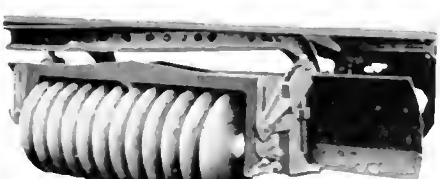

FIGURE 2

The disc attachment for use on motor graders may be attached to either the front or rear of the moldboard (figures 2 and 3 respectively).

The discs should be alloy steel, heat treated, and mounted on a square axle with self-aligning dust-proof thrust bearings on each end. Suitable steel collars, or other arrangements should be provided for holding the bearings and keeping the discs tightly on the shaft.

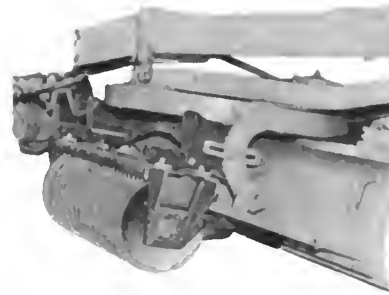

FIGURE 3

The weight of the attachment should not be less than 1,200 pounds and the width approximately 48 inches. The disc should be approximately 20 inches in diameter and spaced on 2-inch centers.

FIGURE 4

The road type disc scarifier assembly should consist of two rows of discs (four gangs), with a minimum of seven discs per section and should be mounted on a four wheel pneumatic-tired low type trailer with steel frame approximately 16 feet long and 4½ feet wide.

The unit should weigh approximately 7,000 pounds. The discs should be approximately 20 inches in diameter and operated with a hydraulic power lift or equivalent apparatus for setting and adjusting the cutting depth.

Distributors

Truck mounted oil distributors of 800 to 1200 gallon capacity are best suited for general maintenance oiling operations. The capacity is sufficient for a day's work with a small crew and if a greater quantity of oil is required, the truck is powered to tow a tank trailer of equal capacity. On smaller jobs the 300 to 600 gallon trailer distributors are preferred. These latter units are easily towed by a one and one-half to two ton truck.

The distributors described are also suitable, when equipped with special spray bars, for applying diesel oil or other liquid agents to roadside vegetation.

Since oiling operations are seasonal, the distributor unit (especially the truck mounted type)

Equipment Rental

(Continued from preceding page)

The information obtained indicates that some portion of all maintenance on State highways is carried out by day labor forces in 42 States, while 14 States report that certain phases of maintenance work are let to contract. General practice, therefore, dictates that maintenance of highways should be performed by day labor forces and that special work be let to contract wherever such work is beyond the capacity of these forces and the items of special work can be readily defined.

Item 3. Does the State own all equipment used on maintenance work or is a portion of the equipment rented from outside parties?

Equipment used on State highway maintenance is, in general, State-owned. It is common practice, however, to rent privately-owned equipment such as power shovels, oil distributors, heavy trucks, etc., for seasonal or emergency work. The purchase of State-owned equipment is usually confined to units required continuously or to special types not readily available on a rental basis. Such a policy is of mutual benefit both to the State and the private equipment owner since it avoids the necessity of a heavy capital investment by the State, and provides work for privately owned equipment which might otherwise be idle.

The recommendations received indicate that all equipment required for normal maintenance operations should be owned by the supervising authority and that outside equipment be rented for special or emergency use.

AVERAGE EXPENDITURES

Item 4. What is the average annual expenditure for rental of State-owned equipment, and for equipment rented from outside parties?

The average annual expenditure for rental of equipment

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should be designed for easy removal from the truck chassis.

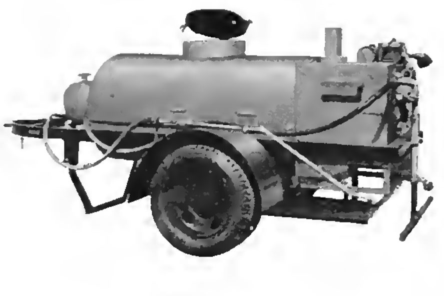

FIGURE 5

Bituminous distributors having a capacity of from 300 to 600 gallons should be mounted on a two-wheel pneumatic-tired trailer. The tank should be elliptical in shape, electrically welded, and so constructed as to permit low center of gravity.

The tank should be equipped with a manhole opening of ample size, thermometer well, an overflow pipe and a discharge opening at the rear of tank with piping so arranged as to permit the following:

1. Fill tank through pump from drums or spray tank.
2. Circulate material in the tank while heating without passing through the spray bar.
3. Spraying from tank through hand spray bar.
4. Drain pump and pipe lines without draining the tank.

The unit should be equipped with at least two sets of 6 inch U-type return heating flues made of heat resisting tubing and located in the lower half of the tank. The heating unit should include the following items:

1. Two removable kerosene burners located in the end of tank shielded so that the flame will not contact the end of the flue.
2. Automatic fuel pump for kerosene with pressure relief valve and bypass.
3. Fuel tank of at least 20 gallon capacity with a filler cap and automatic air relief. The tank should be located away from the burners, preferably at the opposite end of the bituminous tank.

A rotary type pump, powered with an air cooled gasoline engine, should be so

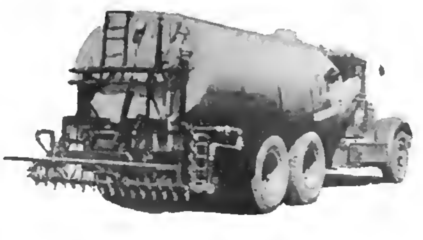

FIGURE 6

arranged that the material can circulate when the valves are closed. The pump should be enclosed in a removable sheet steel housing which will permit heating by return flue gases from the burners or engine exhaust.

The spray bar should be at least $1\frac{1}{2}$ inches in diameter and not less than 4 feet long, fitted with slot type spray nozzle which will produce a suitable fan shaped spray. Fifteen feet of 1 inch diameter heat resisting hose, complete with pipe extension handle and cut-off valve and nozzle, should be provided for hand spraying.

A platform should be provided at the rear so located that the operator can control all operations.

FIGURE 7

Bituminous distributors having a capacity of from 800 to 1,200 gallons should be constructed with steel skids suitable for truck mounting.

The tank should be oval in shape of at least 10 gauge steel, electrically welded, properly insulated and lagged. The tank should be equipped with a manhole opening of ample size, thermometer well, overflow pipe, clean-out opening in the bottom and baffle plates of sufficient size and number to prevent excessive surge. Thermometer well shall be adequately insulated from heating flues.

The distributor should be equipped with at least two sets of 6 inch U-type return heating flues made of heat resisting tubing, located in the lower half of the tank. The heating unit should include the following items:

1. Two removable kerosene burners located in the end of tank shielded so that the flame will not contact the end of the flues.
2. Automatic fuel pump for kerosene with pressure relief valve and bypass.
3. Fuel tank of at least 50 gallon capacity with filler cap and automatic air relief. The tank should be located away from the burners, preferably at the opposite end of the bituminous tank.

The pump should be a positive displacement type located on a base inside of the tank with the drive shaft extending through the shell. The drive shaft should be supported by self-aligning bearings with stuffing box located outside of the tank. The pump should be powered with a water cooled gasoline engine having not less than four cylinders and capable of applying two gallons of bituminous material per square yard for a width of 10 feet at stated truck speeds. The complete pump assembly should be so arranged as to be readily removed from the tank.

Equipment Rental

(Continued from preceding page)

owned by the 26 States reporting was $1,383,270 per State. An additional amount equal to 21 per cent of this average was likewise expended for the rental of privately owned equipment. This latter figure serves to emphasize the dependence now placed on that source.

Item 5. Is State-owned equipment handled by a separate department, by the maintenance department or by the districts?

It was found from the replies that support for each method of equipment administration is about equally divided. Some of the advantages as well as the disadvantages of each method are enumerated;

Under an equipment engineer with special training there should be greater assurance of the performance of mechanical features, the enforcement of necessary working restrictions and insistence on timely upkeep and repairs. On the other hand, this centralization of authority unless accompanied by a knowledge of maintenance problems and operations might well handicap a maintenance organization.

ADMINISTRATION

Administration under a district would of course permit the selection of equipment best suited to its particular conditions and insure its coordinated use. However, under such administration there is always the likelihood of over-equipping or concentrating on specialized equipment. Furthermore, the exigencies and demands of particular work might well overrule practical considerations of upkeep and repair.

Many of the disadvantages of the district method apply equally well to administration by a maintenance engineer. His major concern naturally is the performance of work, generally with a contractor's viewpoint regarding the use of the equipment but without the latter's opportunity

(Continued on next page)

The piping and valves should be of ample size to convey the material without undue friction loss and provided with sufficient valves arranged to permit cutting out the boot, pumping from either end of the tank, inside suction to outside discharge and outside suction to outside discharge. All swing joints should be of the ball bearing type.

The spreader boot should be full circulating lateral swing type of ample size to convey the material to the sprays without excessive pressure or injury to the pump, and should be approximately 8 feet long with a 2-foot, full circulating, separately controlled extension on each side allowing for a 12-foot spread.

The sprays should be double tip, with single valve, and spaced on about 6-inch centers. Flexible metal hose and hand spray assembly should be provided. A separate lever to control each 4-foot section of boot, a lever control for each boot extension, and a hand wheel or crank for raising or lowering the boot assembly should be provided.

The platform should be located so that the operator can reach all controls, as well as the engine pump and operating valves, without moving from the platform.

Tank Car Heaters and Retorts

The two-car capacity two-wheel trailer mounted steam heater is preferred for the lower viscosity liquid asphalts where deliveries are taken from tank cars or storage. In localities where severe winter prevails, the heater may also be used for thawing out culverts or frost boils.

The retort heater, four wheel trailer type, is used for the heavier grades of liquid and paving asphalts required in armor coat, seal coat and retread surfaces. The unit, however, was not recommended by the Atlantic or New England group of States, where apparently heating requirements are handled by either stationary plants or field kettles.

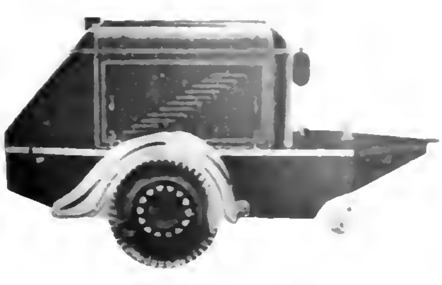

FIGURE 8

The tank car heater should be two-car capacity and capable of heating an uninsulated tank car of bituminous material to a temperature of at least 200 degrees F. within a reasonable time. It should be mounted on a two-wheel pneumatic-tired trailer.

Equipment Rental

(Continued from preceding page)

of writing off the investment at the conclusion of the job. Then too, the purchase of equipment, its repair and upkeep is a specialized job for which the maintenance engineer is seldom trained. He is, however, conversant with the demands of his work and therefore better versed in setting up the control features of the equipment required.

Because of the equal popularity of the three methods of administration, the views of the committee members were taken as the deciding factor. Of the five committee members who expressed a preference, three favored a separate department and two considered the administration of equipment matters should be under the maintenance department.

RENTAL SYSTEM

Item 6. Is State-owned equipment handled on a rental basis?

State-owned equipment is handled on a rental basis in 75 per cent of the States reporting on this question.

Two desirable objectives are reached through use of a rental system. First, it permits creation of a reserve fund from which to finance the cost of repair and replacement of maintenance equipment. Second, the cost of equipment is distributed currently against the work on an equitable and reasonably accurate basis. In addition there is a decided advantage in having a basis of comparison as to cost of operation of equipment in the several districts which normally make up a State highway organization. The information is desirable also if a comparison is to be made between the cost to the State of owning and operating equipment as against the cost of renting privately owned and operated equipment. There would be a further benefit from an administrative point of view, if the policies and rental rates in the

(Continued on next page)

The boiler should be the return, condensate, horizontal type, fully insulated and lagged and equipped with an injector and steam trap. It should be capable of developing from 25 to 40 H.P. under a working pressure of 125 to 135 pounds per square inch. The heating unit should be internal combustion type using fuel oil burners. The fuel tank should have sufficient capacity to operate five hours under maximum load.

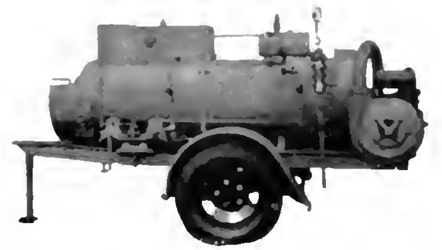

FIGURE 9

The retort booster heater should be mounted on a four-wheel pneumatic-tired trailer. It should have a BTU output of 1,750,000 units per hour, and designed

FIGURE 10

so as to provide a heating capacity equal to the following based on one passage of the asphalt through the unit:

40 F. temperature increase at 164 G.P.M. pumping rate.

90 F. temperature increase at 80 G.P.M. pumping rate.

190 F. temperature increase at 40 G.P.M. pumping rate

Heating should be accomplished by passing the bituminous material over and around the tubes which receive the flame and hot gases from the oil burners. The heating system should be so arranged that the hot gases pass in a downward direction before being exhausted through the stack. The bituminous material should be pumped into the tank at the bottom and out at the top with a reversible type pump. The maximum capacity of the pump should not be less than 165 gallons of fluid asphalt per minute. It should be jacketed and so designed that it can be heated by the engine exhaust or other means, and powered with at least a four cylinder radiator cooled gasoline engine.

The pumping unit should have two speeds in one direction and one in reverse, and equipped with a three-way valve to provide distribution and by-pass facilities.

The oil burners should be adjustable and provided with suitable connections to permit removal for cleaning and repair. They should be designed to burn fuel oil up to and including 28-30 Baumé gravity.

The tank should be fitted with flow-equalizing mechanism to insure uniform circulation of the oil. The tube assembly through which the burner heat passes should be designed to provide for expansion and contraction.

Asphalt Heating Kettles

The asphalt heating kettles from 165 to 300 gallon capacity on two-wheel trailers are the size most widely used on all types of surfaces other than untreated earth or gravel. They have sufficient capacity for normal daily maintenance requirements and can be readily towed by light trucks.

The 300 to 550 gallon capacity, two wheel trailer type kettle, is not a popular choice and its use (mainly by certain Central States) is confined to bituminous plant mixed surfacing. It is noted that in States where these units are used, there is no recommendation for oil distributors.

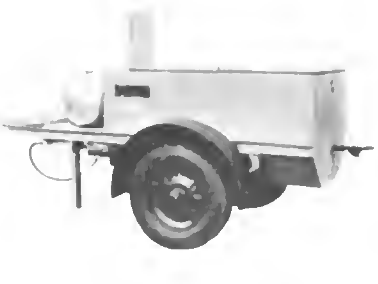

FIGURE 11

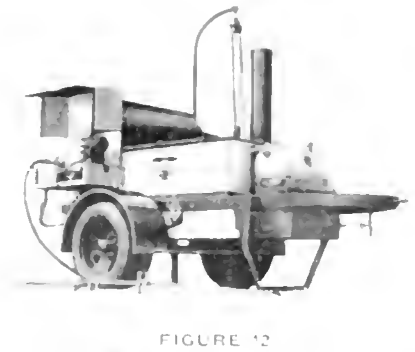

FIGURE 12

CAPACITY Approximate gallons	165	210	300
WEIGHT Minimum pounds	1 300	1 500	2 700
HEIGHT Loading approx inches	46	50	50

Equipment Rental

(Continued from preceding page)

various States were calculated on a basis which would permit comparisons.

Item 7. What method is used for figuring depreciation?

Replies to this question indicate that it is the general practice to establish depreciation rates on a straight line basis with due consideration to first-cost and trade-in values. Only one State reported a varying rate from year to year for units in a given group. One State reported original purchase is from special appropriation and one State reported that entire cost is depreciated in the year of purchase.

COST OF EQUIPMENT

It is possible that legal requirements in some States make it mandatory to secure special appropriations for purchase of equipment. However it should be noted that the true cost of work can not be ascertained if the cost of equipment is not distributed in some manner.

Allowance for depreciation is based on the service life of the equipment and the salvage value at the time of retirement. The service life of each unit in a group of similar equipment units is dependent on (1) the number of hours of operation and the severity of work performed within the given period, (2) indeterminate items such as the skill of operators or care in servicing and (3) the policy followed by different States as to repairs and or replacements. The question of time of replacement has a special significance. It is the policy in some cases to replace units before extensive overhaul is necessary. Obsolescence as well as changes in traffic requirements or improvement of the road system may effect changes in equipment needs and thus limit the period of usefulness of certain units. All these factors must be considered in establishing depreciation rates. There

(Continued on next page)

The asphalt heating kettle should be mounted on a two-wheel pneumatic-tired trailer so designed as to afford a low center of gravity. The heating unit should consist of a fire box, outside shell and removable blow torch, and should have a melting capacity of at least 1,000 pounds of asphalt per hour. The tires and fuel tank should be protected from the heat. The fuel tank should have a capacity of not less than 20 gallons and should be of welded construction throughout and designed to withstand a maximum pressure of 60 pounds per square inch. The pump should be gear type, submerged or with other provision for heating, and powered with a suitable air-cooled gasoline engine. Provision should be made for two hand spray hose connections, and a barrel hoist complete with chain blocks should be included.

Loaders

The belt type loader mounted on two pneumatic tires is generally favored. Two other types of belt loaders are worthy of special mention—one is attached to a motor grader, the other is a self-propelled pneumatic-tired unit with force feed. Second choice is the bucket type loader. The pneumatic-tire mounting is preferred over the track-laying type for the latter unit.

The tractor mount front-end bucket loader has its supporters for loading from stockpiles and slide removal work. It is available for mounting on both the wheel and track-laying type tractors.

FIGURE 13

The belt loader, Figure 13, should be the "Trough" type with rollers spaced not more than 36 inches apart. The belt should be equipped with carrying cleats properly spaced for handling river or creek bed gravel. The cleat length should not interfere with proper troughing. Provision for take-up should be made at the upper end roller. The conveyor should be chain driven with a radiator cooled gasoline engine located above the belt.

The loader should be approximately 26 feet long and have approximately 12 foot clearance at the discharge. The unit should be mounted on two pneumatic-tired wheels.

The belt loader attachment for motor grader, Figure 14, should be the "Trough" type with rollers properly spaced to prevent sag. The belt should be approximately 30 inches wide with provision for take-up at the upper end roller. The unit should be constructed so that the material is forced onto the belt by means of positive force feed mechanism capable of loading at least 60 cubic yards of windrowed material per hour. A discharge height of at least 7 feet is required.

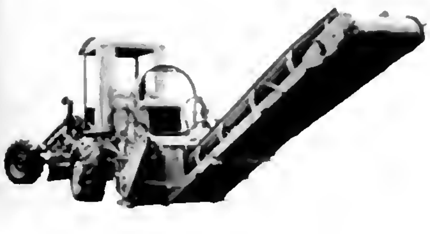

FIGURE 14

The digging depth should be hydraulically controlled with levers located in the cab of the motor grader. The complete attachment will weigh approximately 4,000 pounds.

FIGURE 15

The travel type belt loader, Figure 15, should be the "Trough" type with rollers properly spaced to prevent sag. The belt should be approximately 30 inches wide with provision for take-up at the upper end roller. The unit should be so constructed that the material is forced onto the belt by means of positive force feed mechanism. The unit should be capable of loading material from a windrow or stockpile at the rate of at least 60 cubic yards per hour. The discharge height should be approximately 9 feet.

FIGURE 16

The unit should be self-propelled, mounted on two axles and equipped with pneumatic tires. It should be capable of traveling 25 miles per hour when in transit. The unit complete will weigh approximately 10,000 pounds.

The bucket loader should be powered with at least a four-cylinder gasoline engine and equipped with a two-speed transmission. A feeding worm or device should be provided which will draw the material to the buckets from a width approximating the tread of the loader. The loader should have a capacity of not less than $1\frac{1}{2}$ cubic yards per minute. A swivel belt conveyor approximately 8 feet in length with a clearance of approximately 12 feet should be provided.

The loader should be mounted on pneumatic-tired wheels and should weigh not less than 7,200 pounds and not more than 10,000 pounds.

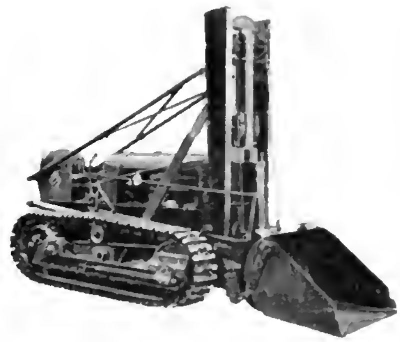

FIGURE 17

FIGURE 18

The tractor front-end loader, Figures 17-18, should have a capacity of from $\frac{1}{2}$ to 1 cubic yard and should be mounted on not less than a 30 H.P. tractor, either wheel or track-laying type. The hoist and frame should be located forward of the tractor radiator. The bucket or scoop should have a replaceable cutting edge and should be designed so that it may be dumped at any desired height up to 7 feet. The unit may be either mechanically (cable) or hydraulically operated. All control levers should be within easy reach of the operator.

On track laying type tractors where the shovel attachment exceeds $\frac{3}{4}$ cubic yard capacity, the tracks should be extended to provide proper balance. A special heavy spring, and wider front axle to provide clearance, will be required on wheel tractor installations.

(Continued in an ensuing issue)

Equipment Rental

(Continued from preceding page)

are also varying emergency conditions. For example, the life of highway maintenance equipment now in service will no doubt be prolonged through more intensive overhauls and replacement of worn parts as a result of the war emergency.

REPAIR AND UPKEEP

Item 8. List the items included in the rental rates for State-owned equipment (operating costs, operating supplies, repair, upkeep, depreciation, overhead, profit, etc.)

The majority of States reported that rental rates include depreciation, cost of repairs, upkeep and all operating costs except wages of the operator. There is practically universal agreement that the wages of the operator should be excluded from equipment rental rates.

In arriving at the cost of repair and upkeep, the following overhead items should be taken into account in addition to depreciation and gradual obsolescence:

1. Major repair, overhaul and upkeep.
2. Storage, insurance, incidentals and equipment overhead.
3. Cost of plant including land, shop buildings and power machine tools.
4. Cost of operating (fuel and lubricants) and servicing costs.

If comparisons are to be made with rental rates charged for outside or privately owned equipment, the following items should be given consideration:

1. Interest on investment or profit.
2. Insurance and surety bond premium.
3. Taxes.
4. Wages of operators.

(Continued in an ensuing issue)

Division of Water Resources Saves 288,800 Miles With Tire Usage Plan

THROUGH a program of tire conservation developed and put into operation by the Division of Water Resources a saving of more than 288,800 miles in passenger car and truck travel has been effected by the division thus far this year.

In a report to Director of Public Works Frank W. Clark on the results of the program to October 1st, State Engineer Edward Hyatt shows that the budget of conserved automobile mileage prepared by the division earlier this year, which proposed to reduce the 1942 automobile use 45 per cent under that of 1941 is not only being met but bettered.

The division has in use 55 passenger cars and eight trucks. Much of its work is of such a nature that automobile transportation is the only means of covering its wide field of activities. This includes supervision of dams, operation and maintenance of the Sacramento Flood Control Project, water master service, snow surveys, stream gaging, flood control and hydraulic construction and special investigations and inspections, all of which necessitate field work in nearly every county of the State. A considerable portion of this field work is located in mountainous or sparsely populated areas not served by bus or trains.

MILEAGE SAVING

Last year was a normal one for division activities. No additional or unusual duties were pursued during the year. Although various rules for conservation of cars were in effect and division cars were used only from a pool, 755,108 passenger car miles and 76,583 truck miles, or a total of 831,691 car miles were traveled in carrying on these activities.

Activities of the division for 1942 were budgeted to 396,700 passenger car miles and 60,000 truck miles, of which 193,842 passenger car miles and 35,000 truck miles were budgeted for the first half of the year.

In spite of the radically reduced mileage proposed by the division to meet emergency conditions, as of October 1, 1942, actual travel in division cars was only 338,188 miles against a budgeted allowance of 351,000 miles. This is 12,812 miles under the budgeted allowance and is particularly impressive when compared to 1941 during which division cars had traveled 627,000 miles up to October 1. It represents a saving in 1942 of 288,812 car miles.

In addition to car and tire conservation reduced travel represented a saving of $11,440 in car travel at 5c a mile. This amount, however, is not a complete saving as much of the business which otherwise would have been conducted by actual contact was done through use of telephone, telegraph and letters.

TIRE CONSERVATION

The tire conservation program of the division was developed shortly after declaration of war by the United States. A thorough review and analysis were undertaken of all the activities of the division to determine where automobile travel could be eliminated or reduced without actual neglect of those duties imposed on the division by various statutes. This survey was designed to:

1. Economize in all possible ways during the emergency.
2. Make automobiles and personnel available for any extraordinary duties in connection with the war and national defense.
3. Conserve automobiles and tires.

At that time the State Engineer issued instructions to functional supervisors covering the prolonging of life of tires by careful operation, speed limitations and restrictions of the use of automobiles by eliminating travel where results could be obtained through correspondence, telephone or telegraph and utilizating trains or buses wherever such means of transportation were available.

The supervisors also were instructed to prepare reports on activities and possible curtailment of automobile use. A committee was appointed to prepare a tire inventory and draft instructions for use of the division's motor vehicles and assist in assembling activity curtailment reports.

TIRE INVENTORY

An estimate was made of the mileage available from the tires on hand. The general formula used was based on an average life of 17,000 miles on past use of tires. On the basis of rigid tire conservation according to previous instructions it was estimated the future average tire life would be 25,000 miles. Mileage run on tires up to the time of the inventory was subtracted from 17,000 and the remainder multiplied by 25/17 to arrive at the estimated remaining mileage.

The estimated combined car mileage available at the time of the inventory for the 55 passenger cars was 891,000 car miles or an average of 16,000 miles per car. Total mileage for the 8 trucks was 186,000 car miles or an average of 26,500. For the 63 passenger cars and trucks total estimated rubber on hand was 1,077,000 car miles or an average of 17,095.

On the basis of this inventory the division budgeted its mileage in such a manner that the average use of cars without replacement in rubber would last until July, 1944. Due to the fact that a portion of 1942 had passed before severe curtailment of travel was placed in effect, the budget for 1942 is larger than that anticipated for 1943.

Various State and Federal regulations concerning reduced speed limitations and care of tires which have been promulgated since the division's conservation program has been placed in effect are assisting in carrying out the purposes of the program. Gas rationing which became effective December 1st also will have its effect upon the program. On the basis of present results, however, even without these additional items, the program of tire conservation developed and put into operation by the Division of Water Resources will provide it with rubber on a curtailed basis sufficient to carry out its statutory duties through July, 1944, when it is anticipated some relief from the pressing rubber problem will be attained through raw or synthetic rubber.

Highway Snow Removal Operations Curtailed by War Emergency Needs

SNOW sports enthusiasts will feel the effect of the war this winter.

Maintenance Engineer T. H. Dennis of the Division of Highways has announced that many recreational roads in mountain areas heretofore kept clear of snow in Winter will be closed to traffic until next Spring in order that highways vitally essential to the war effort may be kept open.

Such routes as U. S. 50 crossing Echo Summit to Lake Tahoe, the Wawona entrance to Yosemite National Park, State Sign Routes 44 and 89 leading into Lassen Volcanic National Park, the roads north and south of Tahoe City and the General Grant Kings Canyon National Park highway are embraced in instructions eliminating them from snow removal operations issued to all District Highway Engineers. Many other mountain roads are affected.

U. S. 50 will be closed from Kyburz to Lake Valley at the foot of Echo Summit on the east side. Mr. Dennis said the order will not isolate any communities in the Lake Tahoe area as the Highway Department of the State of Nevada has promised to keep the roads from Nevada into Lake Valley cleared of snow for Winter recreationists.

NECESSARY WAR MEASURE

"Much as the Division of Highways regrets to take this action," Dennis said, "it is absolutely necessary in order to conserve our snow removal equipment for the duration. Much of this equipment is from eight to 12 years old, breakdowns are sure to occur and we do not have the priorities which would enable us to obtain spare parts and replacements for our trucks, push plows, and rotary snow plows. Furthermore, we are confronted with a growing problem of man-power and face a shortage in skilled operators of snow removal equipment."

Dennis said that the Army insists that U. S. 40, the Donner Summit route, be kept open constantly. For this reason, equipment that normally would be used on U. S. 50 will have to be kept instantly available on Donner Summit for use in case equipment there breaks down.

"We can not afford," he said, "to operate snow plows on U. S. 50 and other mountain highways and then be compelled to remove this equipment on a moments notice, leaving recreationists stalled on partially cleared roads during a storm. We would only jeopardize lives and the war effort by doing so.

"Due to the impossibility of obtaining replacement parts and equipment it will be necessary to hold snow removal equipment formerly used on certain routes as stand-by units in the event of breakdown of units now engaged in removal of snow on roads more essential to the war effort. The War Production Board has informed us it will not approve any replacement parts except for equipment used on roads directly essential to the conduct of the war.

"We are unable to obtain priorities necessary for obtaining parts or metal for making repairs and during storms such delays would close roads unless standby units were available."

Many communities in mountain areas, Dennis declared, have been warned that it may become necessary to discontinue snow removal at any time. When this occurs, signs will be placed at both ends of roads leading to these communities reading "SNOW NOT REMOVED BEYOND THIS POINT."

Among other roads listed by Dennis for closing under the snow removal ban are: State Sign Route 89 from its junction with the Susanville Road to Greenville; State Sign Route 138 leading to Big Pines Park in Los Angeles County and State Route 190 leading to Camp Angeles in San Bernardino County; the Big Trees Highway in Calaveras County, closed at White Pines; Sonora Pass Highway closed at Long Barn. State Sign Route 20 east of Nevada City, closed at Washington Road.

Other roads which may be closed if serious breakdowns occur to equipment now on roads essential to the war effort, are: Route 20, Weaverville to Redding; Route 82, Etna Mills to Montague; Route 83, Sierra County line to Blairsden; Route 35, Hayford to Douglas City; and Route 28, Junction of Route 73 to Cedarville.

Snow removal operations in the Lake Arrowhead district of San Bernardino County will be maintained, Dennis said, owing to the fact that several thousand all-year residents in that area must be served.

England Organizes Planning Officers for Post-War Development

On July 1, 1942, most of the planning powers and duties of the Ministry of Health were transferred to the Ministry of Works and Planning, which thus becomes the central authority for town and country planning in England and Wales.

"The object of the Government's policy is to secure the right use of the land of the country for all purposes. The Ministry has accordingly been charged with the task of guiding the formulation by local authorities in England and Wales of town and country planning schemes which will adequately reflect the national policy for urban and rural development. . . .

"In order to facilitate collaboration with local authorities, the Minister will appoint Planning Officers, with headquarters at convenient centers, who will be available to help and advise them. Each of these officers will keep the Minister informed of the problems of the authorities in his area, and will keep the authorities informed of the requirements of national policy as it is developed."

Arrow points to tunnel No. 1 under construction through ridge of Mt. Williamson on Angeles Crest Highway in San Gabriel Mountains

Angeles Crest Highway Construction Stopped as Unessential to War Effort

COMPLETION of the Angeles Crest Highway, State Route 61, through the San Gabriel range of the Sierra Madre Mountains will have to wait until after the war. All work on this project has been stopped by order of the War Production Board for the reason that it is a purely recreational road and not essential to the war effort.

The Angeles Crest Highway was being built jointly by the United States Public Roads Administration and the California Division of Highways. The new route begins at the Foothill Boulevard and La Canada in Los Angeles County, extends up the Arroyo Seco and passes through the San Gabriel Mountains to an easterly terminus in Camp Angeles at Big Pines.

Passing Buckhorn Flats, the new highway will serve the Pasadena public camp grounds. The shortest present traveled distance from Los Angeles to Big Pines is 107 miles. The distance by the Angeles Crest Highway will be approximately 64 miles, with a saving of 43 miles.

Grading and surfacing of the route from La Canada to Cedar Springs, a distance of 37 miles, and 21.28 miles of the highway extension from Red Box to Tunnel No. 1, had been completed when the order to cease construction was issued.

This project is notable from an engineering standpoint by reason of the necessity for boring two tunnels, one 675 feet and one 474 feet in length through solid rock. On the section between Cedar Springs and West Islip Saddle, there is very little soil and 80 percent of the excavation must be blasted. Two inclined ridges projecting from the face of Mt. Williamson are so steep as to make tunnels necessary. Three of the four portal locations are on nearly perpendicular rock faces, 50 to 75 feet above the canyon floor.

From West Islip Saddle, the new highway will run along the northerly side of Mt. Islip and North Baldy Peak at elevations of from 6,500 to 7,500 feet above sea level.

To avoid the building of construction roads necessary to by-pass the tunnel sites for roadway work ahead,

Arrow points to pilot trail for proposed continuation of route across slope of Mt. Williamson

a rather difficult job of tunnel boring was undertaken. Beginning at the westerly portal of Tunnel No. 1, a small pilot drift 9 feet wide by 10 feet high, was rapidly excavated at the crown of the tunnel, this size opening being sufficient to pass air equipment and crews ahead for work on Tunnel No. 2.

Excavation was then immediately started on Tunnel No. 2 with a 11-foot by 14-foot pilot drift at grade, this size being adequate for passing heavy grading equipment. Simultaneously with the start of construction of this pilot drift in Tunnel No. 2, excavation of the full face of Tunnel No. 1 was launched and both operations progressed at the same time.

West Islip Saddle, which will be a land mark on the new highway, also will be the northerly terminus of San Gabriel Canyon road, Route 62 from Azusa on Foothill Boulevard to a point four miles beyond Crystal Lake.

Several branch roads have been completed and are in use.

Equipment widening tunnel No. 1 bore. No. 2 bore entrance is seen in background

Highway Bids and Awards for November, 1942

ALAMEDA COUNTY. [illegible] Contract awarded to [illegible] $[illegible]

CONTRA COSTA COUNTY. Between [illegible] District IV, Route 75 [illegible] $137,494 [illegible]

FRESNO COUNTY. At the intersection [illegible] District VI [illegible] $24,492 [illegible] $29,454 [illegible]

KERN AND LOS ANGELES COUNTIES. [illegible] District IX [illegible] Contract awarded to Griffith Co., Los Angeles, $141,168.

KINGS COUNTY. Between 1.2 miles [illegible] District VI, Route 125 [illegible] $179,115.

LOS ANGELES COUNTY. Between 2 [illegible] District VII, Route 168, 178 [illegible] Contract awarded to [illegible] $29,122.

LOS ANGELES COUNTY. On Rebeck [illegible] District VII [illegible] Contract awarded to [illegible] $82,077.

LOS ANGELES COUNTY. On Lakewood Boulevard at [illegible] Compton Boulevard, and Imperial Highway, traffic signal systems to be furnished and installed. District VII, Route 168, Section A. C. D. Draucker Co., Los Angeles, $32,200. Contract awarded to Econolite Corp., Los Angeles, $[illegible]

SAN DIEGO COUNTY. At intersections of Harbor Drive with 32nd Street, 28th Street and Pacific Highway, traffic signal systems to be furnished and installed. District XI, Harbor Drive South. C. D. Draucker Co., Los Angeles, $24,416. Contract awarded to Econolite Corp., Los Angeles, $19,823.

SAN DIEGO COUNTY. At intersections of Rosecrans St. with Lytton St., Midway Drive & Barnett St. and at Mission Valley Road and Taylor Street, traffic signal systems to be furnished and installed. District XI. C. D. Draucker Co., Los Angeles, $42,130. Contract awarded to Econolite Corp., Los Angeles, $37,679.

SAN DIEGO COUNTY. On Harbor Drive in the city of San Diego, over Switzer Canyon Creek and the tracks of the Atchison, Topeka and Santa Fe Railway, an overhead crossing to be constructed. District XI. J. E. Haddock, Ltd., Pasadena, $363,340; Trewhitt, Shields & Fisher, Fresno, $373,671; V. R. Dennis Construction Co., San Diego, $374,866; L. E. Smith, El Cerrito, $392,235; Carlo Bongiovanni, Los Angeles, $394,552; The Contracting Engineers Co., Los Angeles, $411,565; Ralph A. Bell, San Marino, $433,891; United Concrete Pipe Corp., Los Angeles, $444,145. Contract awarded to M. H. Golden Construction Co., San Diego, $329,322.

SAN DIEGO COUNTY. Widening a bridge in the city of San Diego about 4 miles north of the Civic Center across San Diego River. District XI, Route 2, Section SD. V. R. Dennis Construction Co., San Diego, $63,637; Bent Construction Co., Los Angeles, $65,773. Contract awarded to Contracting Engineers Co., Los Angeles, $41,947.

SAN DIEGO COUNTY. In the city of San Diego, at Rosecrans and Hugo Streets, a traffic signal system to be furnished and installed. District XI. C. D. Draucker Co., Los Angeles, $6,221. Contract awarded to Econolite Corp., Los Angeles, $5,793.

SAN FRANCISCO CITY AND COUNTY. On Third Street, between Custer Avenue and Twenty-third Street and between Mariposa Street and Fourth Street, about 1.3 miles to be graded and paved with asphalt concrete on portland cement concrete and crusher run base. District IV. The Fay Improvement Company, San Francisco, $319,068. Contract awarded to Chas. L. Harney, San Francisco, $282,853.

SAN JOAQUIN COUNTY. Washington Street & Fresno Avenue, between San Joaquin River and Route 75, about 2.6 miles to be graded and surfaced with plant-mix on cement treated base. District X. Elmer J. Warner, Stockton, $128,733; M. J. B. Construction Co., Stockton, $133,578. Contract awarded to A. Teichert & Son, Inc., Sacramento, $120,140.

SAN JOAQUIN COUNTY. JX Road and Eldorado Road, between State Highway Route 5 and Durham Ferry Road, about 2.4 miles to be graded and surfaced with plant-mixed surfacing on C.T.B. and on earth subgrade and bituminous surface treatment to be applied. District X. Elmer J. Warner, Stockton, $84,153; Fredrickson & Watson Construction Co., Fredrickson Bros., Oakland, $87,533; M.J.B. Construction Co., Stockton, $88,122. Contract awarded to Louis Biasotti & Son, Stockton, $78,686.

SANTA BARBARA COUNTY. Between Casmalia and Santa Maria, about 13.0 miles to be graded and surfaced with plant-mixed base. District V. Cirap, Cooke & M. B. E. Son, Berkeley, $725,395; Clyde W. Wood, Inc., Los Angeles, $891,069; Bressi & Bevanda Constructors, Inc., Los Angeles, $1,116,011. Contract awarded to Fredrickson & Watson Construction Co., Fredrickson Bros., Oakland, $701,195.

SOLANO COUNTY. At Benicia, on 14th Street and on "H" Street, about 1.1 miles to be graded and surfaced with plant-mixed surfacing. District X. Chas. L. Harney, San Francisco, $62,953. Contract awarded to Fredrickson & Watson Construction Co., Fredrickson Bros., Oakland, $52,341.

SOLANO COUNTY. Solano Avenue between Fourth Street in Vallejo and Route 7, about 1.3 miles to be graded and surfaced with plant-mixed surfacing. District X. A. G. Raisch, San Francisco, $66,098; E. A. Forde, San Anselmo, $66,475. Contract awarded to Chas. L. Harney, San Francisco, $65,132.

SOLANO COUNTY. Near Vallejo, Sacramento Street, between Route 208 and Frisbie Street, about 0.9 mile to be graded and surfaced with plant-mixed surfacing. District X. A. G. Raisch, San Francisco, $41,420; Chas. L. Harney, San Francisco, $43,918. Contract awarded to E. A. Forde, San Anselmo, $41,128.

Vegetative Slope Protection on Access Road Cuts and Fills

(Continued from page 2)

tion of hand labor in raking down the topsoil and picking up the slough.

The interests of both the contractor and the State would probably best be served by including in Roadway Excavation, the work of slope roughening, stripping, stockpiling and spreading topsoil. The Slope Erosion Protection item would then include only seeding and application of straw. Recent experiments indicate that with certain heavy types of topsoil an effective growth of vegetation may be secured by seeding alone. Where this type of soil occurs the straw blanket should be dispensed with. Seeding in this event could be performed as extra work.

Straw applied at the rate of three tons per acre covers the slope rather sparsely. A rate of four tons per acre would appear to be preferable.

Attention has been given on all these contracts to the shape of intercepting ditches. As may be observed on older sections of highway a sharp V type ditch is an invitation to trouble.

The resulting erosion cuts into unfertile soil which is unfavorable to vegetation.

It has been found both by our own experience and the Soil Conservation Service that a ditch with a broad rounded cross section covered with topsoil is most suitable for the control of runoff water and the elimination of erosion.

"Who was our first President?" asked the American lawyer, hoping to test the intelligence of a witness.

"Washington," replied the witness.

"Right! And who was our second President?"

"John Adams."

"Correct!"

There was a pause.

"He's doing fine," whispered a friend of the lawyer. "Why don't you keep on?"

"I'm not sure who was the third myself!"

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CALIFORNIA STATE HIGHWAY SYSTEM

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

EARL WARREN, *Governor of California*

JANUARY, 1943

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California

C. H. PURCELL, Director   GEORGE T. McCOY, State Highway Engineer   J. W. HOWE, Editor   K. C. ADAMS, Associate Editor

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Planning for Constructive Public Works After the War is Aim of New State Administration

By EARL WARREN, Governor of California

WITH our Nation at war, we, as Californians, must give our first thought to rendering full and efficient assistance to the war effort. We must, in all departments of State Government, center efforts upon perfecting and streamlining State cooperation in the war effort.

While we face no greater immediate challenge than to turn loose the full power of State energy in the development of contributions to the war effort, we must also keep in mind the companion problem of preparing for the let-down which inevitably follows a war. I hold that it is possible to plan now in a manner which will add to our strength when these post-war tests occur.

Each department of State Government is now confronted with a dual problem—the streamlining of efforts to speed the day of victory in the war and the planning for the peace to come. Patriotic duty is now causing dislocations which will later sorely test our recuperative powers. As we plan now for the full utilization of manpower in war effort we must, therefore, also plan for the full utilization of manpower in the days of peace to come.

As Governor, it is my intention to afford Mr. C. H. Purcell, the new Director of Public Works, all support possible in the advancement of solutions of problems covered by this broad policy. Whatever is required in bridge and highway construction and maintenance for the transportation of troops, materials and supplies to advance the successful prosecution of the war, will be done by the Department of Public Works. The department will continue, through its Division of Water Resources, to afford every protection possible to transportation and communication systems and to farm lands and cities in need of protection from winter floods.

As a planning agency of State Government, the Department of Public Works, will have an important function to perform in helping to streamline our preparations for the post-war period. Vast shipbuilding, aircraft and war material industries are changing our economy. If we are to move forward rapidly after the war, we must plan those things now which attract and hold industrial effort which affords employment for our manpower. Proper highway and natural resource development will play an important part in encouraging such industrial activity.

The Department of Public Works can also make an important contribution to State welfare by planning safeguards against actual unemployment during the period of transition between war economy and peacetime economy.

Many phases of public works are adaptable to a construction program designed to relieve conditions of unemployment which are certain to occur during the post war adjustment. Construction of public buildings presents some opportunities. Highway construction will play a large part in such a program as it is one of the most flexible of all public works improvements. The units of a highway program may be changed in types of construction and to fit in with varying ratios of available men and machinery. A well planned highway program may be carried forward and stopped at most any point and the benefits to the public of the investment immediately realized as far as the improvment goes.

These projects will afford not only employment but an opportunity for the resettlement of returning veterans and those affected by the post-war shift away from industrial centers.

With all phases of construction now curtailed to projects needed for the war effort, the principal activity of the Department of Public Works is one of maintenance and planning. The use of available funds and personnel in preparation of well planned and properly correlated programs for the future is important. Planning now, so essential to proper and useful expenditure of public funds to be made during the adjustment period, will involve careful consideration of many factors.

The complexion of California is becoming more and more industrial. The 1940 census, giving the State a total population of 6,907,000, revealed an increase of nearly 22 per cent during the thirties. On January 1st a year ago the population was authoritatively estimated at 7,350,000; today the estimate is about 7,600,000, an increase of more than 11 per cent in the last three years. Analysis of the figures upon which these totals were compiled shows definitely that the greater increases occur in the industrial areas—Vallejo, the bay counties, Burbank, Long Beach, Los Angeles and San Diego.

Trends indicated by these changes must be given proper consideration in planning future public works. Transportation facilities must be planned particularly in relation to the trunk system of highways; the accessibility to the principal thoroughfares within that system; arterials into, through and around metropolitan areas; secondary roads; new bridge facilities; and replacement of inadequate bridge structures and special attention must be given highway problems linked with opportunities for development of our mineral resources.

Under this plan, California will be prepared to pass through the period of adjustment following the war, with a public works program consisting of properly designed projects to meet the needs of the State as it climbs back to a balanced economic status.

C. H. Purcell, State Highway Engineer Becomes Director of Public Works

AFTER fifteen years service as State Highway Engineer of California, Charles H. Purcell, builder of the San Francisco-Oakland Bay Bridge, on January 5th assumed the office of Director of the Department of Public Works under appointment by Governor Earl Warren.

Born in North Bend, Nebraska, January 27, 1883, Mr. Purcell attended Stanford University for one year in 1902. The death of his father caused him to go to Chicago, where he took the first job that was offered, which happened to be messenger in the Grain Pit.

He had early set his heart on becoming an engineer, so after twelve months in Chicago, he gave up his position and enrolled in the University of Nebraska. He was graduated as a civil engineer in 1906.

He gained his first engineering experience during his sophomore and junior years by working Saturdays and during vacations as a draftsman for the Burlington Railroad. After receiving his diploma, Mr. Purcell became an instrument man and later was appointed resident engineer for the Union Pacific in Wyoming. Here he built his first bridge. It was a 200-foot, steel girder, concrete-foundation structure across Bitter Creek. From that time on bridges were his hobby.

Charles H. Purcell
Director of the State Department of Public Works of California

WENT TO PERU

From Wyoming, Mr. Purcell went to Ely, Nevada, where the Guggenheims were building a $17,000,000 smelter. The chief engineer was Tom Cox. He gave young Purcell a job never dreaming that one day Purcell, as chief engineer of the most famous bridge in all of the world would send for him and place him on his staff of engineers.

About the time that the Guggenheim smelter was completed, American capital was looking with interest toward the mines of South America and Mr. Purcell, with a small company of men who had worked with him at Ely, went to Peru, where for two and one-half years he acted as principal assistant chief engineer for the Cerro de Pasco mines in charge of design and erection of steel buildings.

His job in Peru finished, Mr. Purcell went to New York and then in 1910 came to California. He went to Marysville to design steel work for gold dredgers then being built in the Oroville district. From here he went to Oregon and took a job as chief engineer of a Columbia River logging railroad. Oregon at this time was building a number of road bridges of steel construction. Mr. Purcell proposed that concrete bridges be built across the smaller streams.

BUILT COLUMBIA RIVER HIGHWAY

As a result of this work, Mr. Purcell was appointed the first bridge engineer for the then newly organized Oregon State Highway Department, later becoming assistant to the State Highway Engineer in designing and constructing Oregon's first paved highway in Jackson County.

Leading citizens of Portland were dreaming of a great highway along the Columbia River and they turned to Mr. Purcell to help them build it. Mr. Purcell resigned from his State position and became the bridge engineer of the Columbia River Highway project.

When this task was completed he returned to his post as State highway and bridge engineer. He remained for a year and then for two years was bridge engineer for the

(Continued on page 11)

Report Tells Many Drastic Changes In Highway Activities Caused by War

PREFACING the Thirteenth Biennial Report of the Division of Highways, covering the period from July 1, 1940, to June 30, 1942, Charles H. Purcell, who was elevated by Governor Earl Warren from the post of State Highway Engineer to the office of Director of the Department of Public Works, calls attention to post-war highway problems which must be anticipated and the need for careful study and planning for future highway development.

Referring to the last biennium and its effects upon the Division of Highways, Mr. Purcell says:

"During this period, the country has undergone the severe transition from a peace time economy to one geared to the necessities of all-out war effort. Concurrently with this transition in National life, the activities of the Division of Highways have undergone drastic and rapid changes.

"For many years improvement to the California State Highway System has been on a definite development program aimed to provide adequate facilities for the motor vehicle transportation of the entire State and highway budgets have been prepared on this basis.

"The budget for the biennial period July 1, 1941, to June 30, 1943, was so prepared and adopted by the California Highway Commission on December 30, 1940. During 1941, as the possibility of war became more imminent and the National Defense Program rolled into action, construction costs rose rapidly so that a complete revision of the budget became necessary. To meet the rising costs required shortening or changing the design of some budget projects and elimination of others. This revised budget was adopted by the Commission on November 10, 1941.

"It is now apparent that, with the shortage of rubber, speed limitation and the rationing of gasoline in the west this Fall, revenue from the State gas tax will be greatly reduced. It is anticipated that further reduction in the State Highway Budget in a sum of between five and six million dollars will be necessary before the budgetary biennium ends on June 30, 1943, so that projects financed with State funds will be within the decreased revenue.

"During the years of 1940 and 1941, the Division of Highways and the Public Roads Administration working in conjunction with Commanding Officers of the Army, Navy and Marine Corps establishments in California, prepared a comprehensive program of projects approved by the War or Navy departments for the construction of roads serving as access to military and naval establishments and to industrial plants engaged in defense construction. As most of these access road projects are situated off the State Highway System, it was impossible to use State highway funds for either construction, engineering, or right of way on such work. Under a 1940 amendment to the Federal Aid Highway Act, it was possible, however, to finance surveys and plan preparation from Federal Aid and Federal Aid Secondary funds apportioned to California. On November 19, 1941, the President approved the Defense Highway Act which provided funds for construction of Access Roads.

"By the outbreak of the war on December 7th, California had so advanced the preliminary engineering on the access road program, that of the total program in this State of nearly \$45,000,000 in projects requested by the military, surveys had been completed and plans prepared on work to the value of more than \$20,000,000. The \$150,000,000 in Federal funds authorized for access road construction throughout the Nation became available about the first of the year and the first certification for construction of a California project was received late in January and bids opened on February 18, 1942. Since that time a large percentage of the work of the department has been in advancing construction on certified access projects.

"While the access road program was proceeding, needed improvements were being made on the Strategic Highway Network, which consists of existing highways officially designated by the War Department as essential to defense and military operations. This National network was adopted after several years of joint study by Army officials, the Public Roads Administration and the State highway departments. The strategic highways are shown on a National diagrammatic map revised to May 15, 1941. In general, the network is located on the Federal Aid Highway System and on State highways and that portion situated in California comprises approximately 5,000 miles.

"During the late Spring of 1941 when it became evident that drastic curtailment was necessary in the peace time use of materials which were needed for war purposes, the Federal Administration inaugurated the priority system for control of the use of critical materials. Foreseeing possible restrictions on highway activities from the lack of materials, the Division of Highways immediately assigned engineers from the Headquarters staff to a study of the situation and of required procedures for securing adequate priority preference ratings for materials needed in highway construction. Assignment of these engineers has proven to be of the greatest benefit to the work of the Department and their knowledge of priority procedure has prevented many delays, which might have seriously impeded construction operations.

"The increasing Federal restrictions placed on the normal use of materials, equipment and processes began having a marked effect on highway construction during the Fall of 1941. On April 9, 1942, Conservation Order L-41, and its amendment L-41-600, promulgated by the War Production Board, placed nonessential construction under rigid control. Under the requirements of this order highway activities, amounting to a

(Continued on page [illegible])

New Combination Bank Protection Constructed on Eel River near Dyerville

By G. A. TILTON, Jr., Asst. Construction Engineer

DURING the winter of 1939-40, after a long period of stability, the Eel River at the confluence with the South Fork, for some reason yet undetermined, decided to change its course.

At the beginning of the meander in 1939-40 the bank of the river was 400 feet away from the highway. The winter of 1940-41 saw this distance cut to 200 feet. Finally in the 1941-42 season the incursion had reached and attacked the highway at a point immediately below Dyerville on the famous Redwood Highway. It was evident that another winter season would find the roadbed washed out.

COMPROMISE DESIGN USED

Immediate studies were made and designs considered to prevent threatened destruction of the highway. Design proposals incorporating excessive amounts of critical materials needed for the war effort were discarded. Finally a compromise design was accepted that would give maximum protection with a minimum use of critical materials already on hand.

The adopted design was a new combination bank protection consisting of medium rock riprap 2 feet 9 inches thick, normal to a 1½:1 embankment slope, and 6 inch x 25 foot flexible rock and wire mattress 5 feet above the toe of the rock riprap.

The bank to be protected consisted of alluvial silt extending to a depth of 15 feet below the stream bed. Borings indicated that the silt was underlain with an undetermined depth of gravel. Experience on the Eel River indicated that any design which did not provide against scour at the stream bed or for 15 feet or more below the stream bed level, would be subject to damaging scour and failure.

35-FOOT FLOOD HEIGHT

Although low water discharge of the Eel River in the dry season is comparatively small, high water discharge during winter and spring flash flows, approximates 300,000 second-feet and rises 30 to 35 feet above the low water stream bed at this point.

To protect a bank against the tremendous forces exerted on the outside of such a bend demands first-class A-1* bank protection.

In the case of easily erosible material as existed in this case on the outside of a bend, maximum scouring occurs, not near the surface, but near the bottom of the bank at stream bed level. As has been demonstrated by experiment, there is a diagonally downward flow of water on the face of a steep bank on the outer side of a bend.

DIAGONAL VELOCITY DEVELOPED

Head developed by superelevation of the water surface next to the outer bank induces a diagonally downward velocity of the current. This current causes particles of solid material to become dislodged from the bank and these particles are acted upon by the force of gravity in addition to the downward velocity of the water, causing increasing scour towards the bottom.

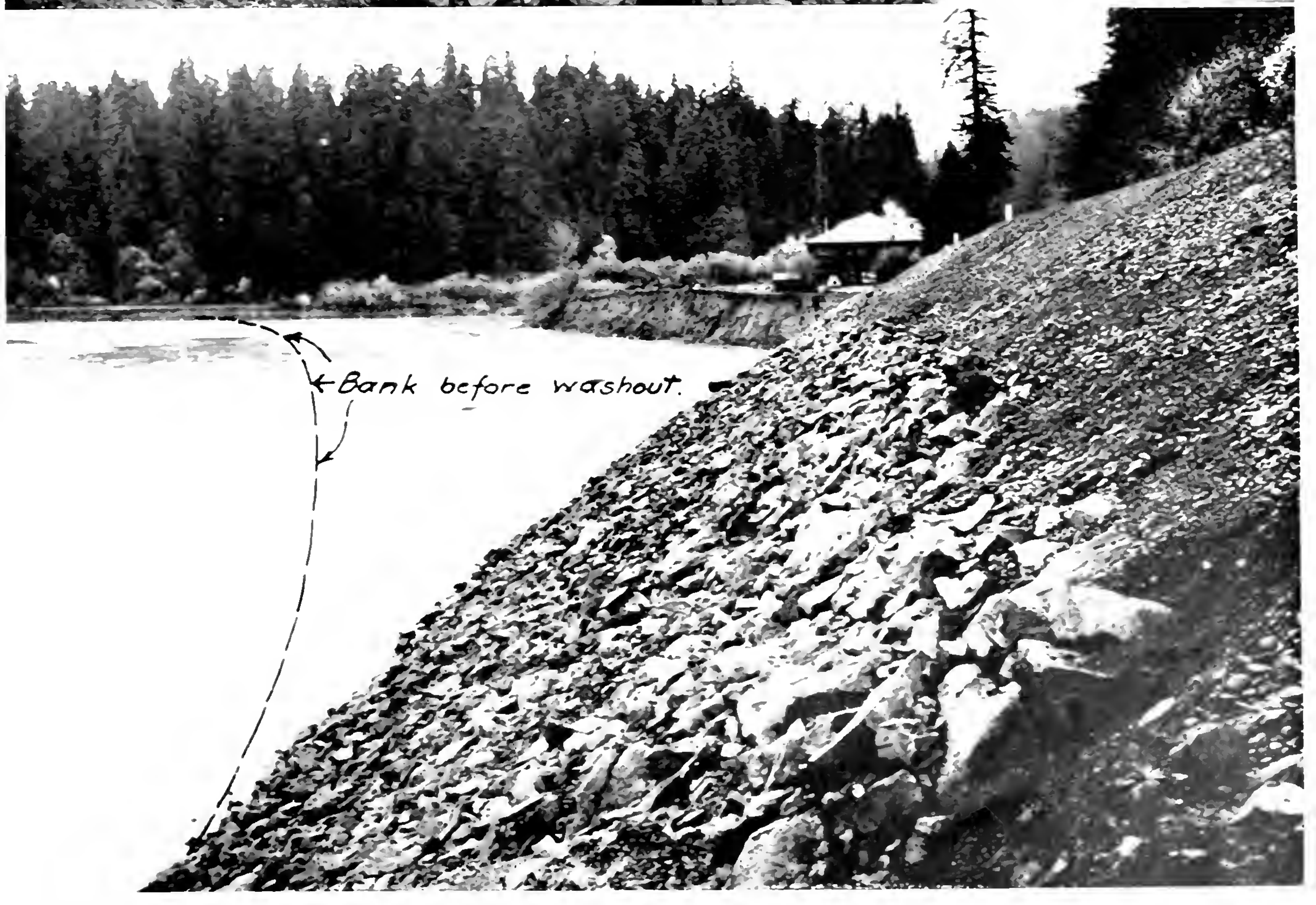
Since this downward current causes scour along a more or less inclined bank, a horizontal obstruction is a most direct means of intercepting and destroying it before it undermines the installation.

The rough surface of the rock riprap tends to create turbulence of stream flow and lessens the effect of the downward velocity. The horizontal rock and wire mattress 5 feet

(Continued on page 20)

*See July, 1939, issue California Highway Public Works Magazine.

Rock riprap and wire mattress protection of left bank of Eel River below Dyerville. Left: general view, looking downstream Right: detail of mattress and cable tie.



Left bank of Eel River looking upstream toward D[illegible] highway which is marked by white posts. Bottom [illegible] bank of a [illegible]

Culvert Outlets and Endwalls On California Highway System

By R. ROBINSON ROWE, Assistant Engineer, Bridge Department and
CLARENCE F. WOODIN, Assistant Maintenance Engineer

FOREWORD

This is the fifth of a series of technical abstracts from a joint departmental review of culvert practice of the California Division of Highways, by a committee composed of G. A. Tilton, Jr., Assistant Construction Engineer; Robert L. Thomas, Assistant Engineer Surveys and Plans; and the writers. Following the preliminary outline of subjects in the August number of the California Highways and Public Works, the series opened with: September issue—Comparative Hydrology Pertinent to California Culvert Practice; October issue—Debris Control at Culvert Entrances on California Highways; November issue—Highway Culvert Location and Slope from a Review of California Practice; December issue—Culvert Entrances and Headwalls on California Highway System.

The series continues with a study of factors influencing designs of outlet works. For reasons given, these factors at any one site are variable with time and beyond control by the designer. Hence the type of works must be selected by judgment rather than rule; and maintenance should modify the works rather than restore the initial conditions.

THE outfall of a culvert is functionally the antithesis of its approach. One is an accelerating transition channel, the other a decelerating transition. One accumulates potential energy in its forebay and transforms it to kinetic energy, the other must dispose of the excess energy by dissipation or transformation. The entrance is usually an artificial, permanent control for the stream channel; hydraulics at the outlet depends upon downstream controls, usually natural and often unstable.

Constructing the outfall works identically the same as the approach does not satisfy the reversed conditions, for reasons which are worthy of review, but the Committee found that a large proportion of culvert appurtenances were designed in this way. Particularly, if the headwall is straight, U-shaped, flared or warped, so is the endwall. If there is a paved approach apron with deep cut-off, then the outfall apron and downstream cut-off will match it. If headwalls protect embankment against a stage 3 feet above crown of culvert, then so do the endwalls. Occasionally the symmetry of upstream and downstream protection appears as ridiculous as would a debris barrier at outlet to match one at entrance.

However, it was encouraging to find that this illogical symmetry was more typical of the older than the newer installations. More recent construction showed a rational trend in the design of outfall works. Performance of these newer designs was observed for this report, although many have not yet experienced extreme floods.

Design Variables

For many sites, there will be natural security of culvert outfall because of some combination of small discharge, low velocity, maturity of channel or durability of channel perimeter. For others, the design of outfall works must consider the following variables:

1. The energy of effluent. This may be expressed as energy head above mean elevation of invert. If more than one-third of this energy head is kinetic, then velocity is supercritical and the momentum equation will govern in the outfall transition. On the sketch of typical profiles **(Fig. 29)** the plus signs above vectors indicate supercritical (shooting) and minus signs, subcritical (streaming) flow. These terms derive from the accepted conception of "critical flow," when total

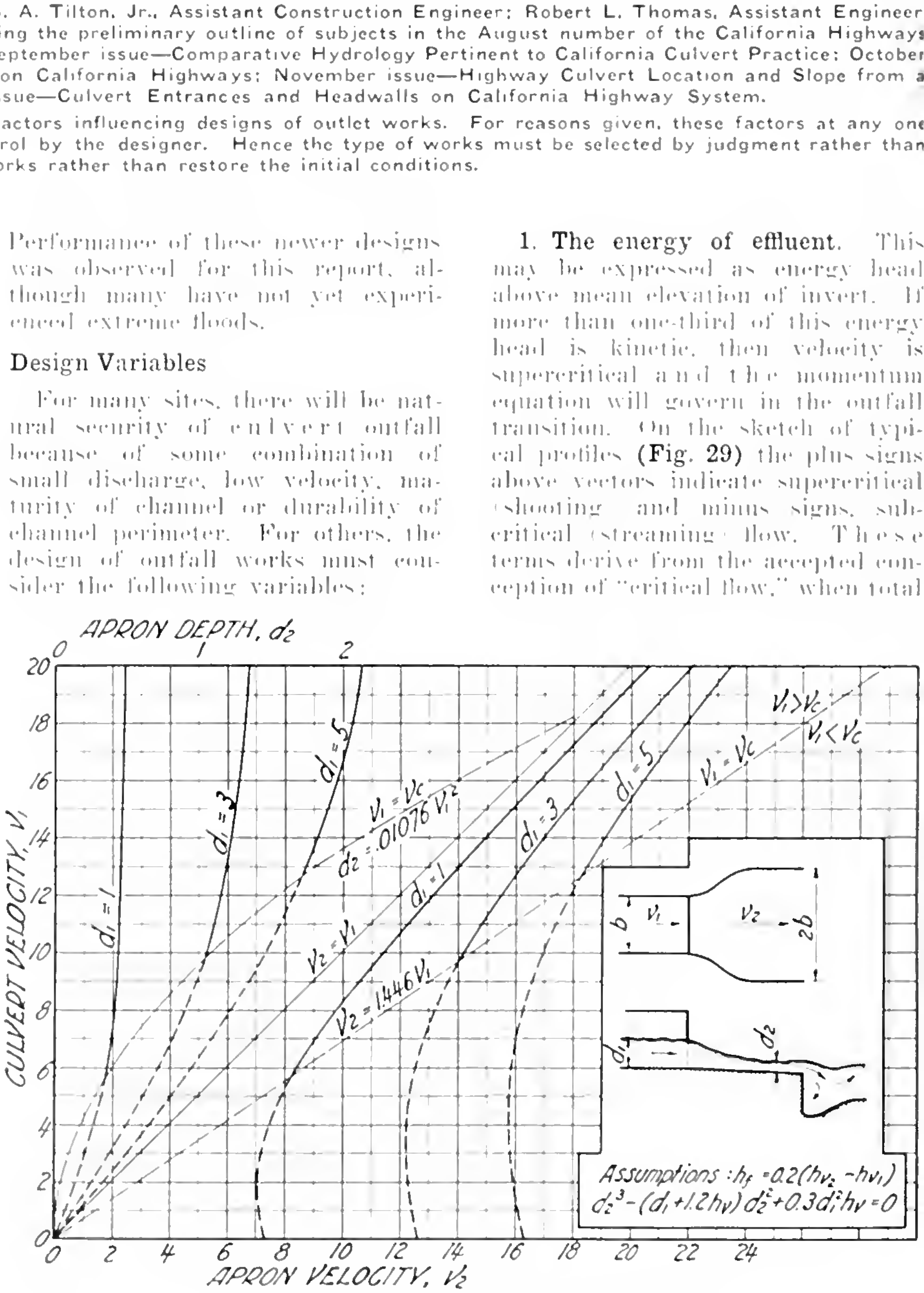


FIG. 30. Guide Chart, for estimating free-outfall depth and velocity on apron from depth and velocity at culvert outlet

energy is a minimum and mean depth is double the velocity head.

2. The get-away of downstream channel. In **Figure 29** three conditions are recognized—submerged, controlled, and free—and the influence of these conditions is shown qualitatively. If get-away is poor, the outlet will be submerged and flow full, so transition velocities will be slow or moderate. If get-away is good, the outlet will be free and high velocity will be maintained or developed in the transition. For intermediate get-away, action of the transition must be studied to distinguish between accelerating flow **(Case B)** and the hydraulic jump **(Case F)**.

3. The security of bed against scour. Bed scour may be expected at any free outlet, but not necessarily at ends of all steep culverts. In **Case F**, for instance, the jump may occur on the apron or within the culvert conduit; downstream from the jump, velocity should be lower than the ruling velocity of the stream—hence endurable by the bed. Durability of the bed depends on the hardness and consolidation of an erosion surface or on coarseness of overlying products of erosion.

4. The security of banks against scour. Banks may expose strata of diverse durability. Scour is most serious if the softer layers are near mid-depth, when upper layers will be undercut. Soft layers near bed level will be intermittently protected by talus from above. Scour may progress from direct attack of oblique flow in the expanding transition, or by eddy action if the transition is too rapid.

5. The future control of stream flow. For a channel of nearly constant width, elevations of rock ledges or coarse bars will control stages for some distance upstream. If such are lacking, the bed level is probably unstable and the trend (scour or deposit) should be determined. Submerged outlets may become free, and vice versa. If width of channel is far from constant, the control may be a constricted section. Riparian vegetation is a potent factor, but permanence should be questioned.

Free Outlet Transition:

The typical free-outlet culvert is about half as wide as the natural channel. As shown in **Figure 29, C, E, and G,** the water surface must drop because of freedom. This drop will increase velocity and reduce area of wetted section; hence depth must be less than half that in the culvert. Since the energy equation (Bernoulli's Theorem) governs accelerating flow, the reduction in depth and potential energy must be compensated by an increase in kinetic energy and velocity.

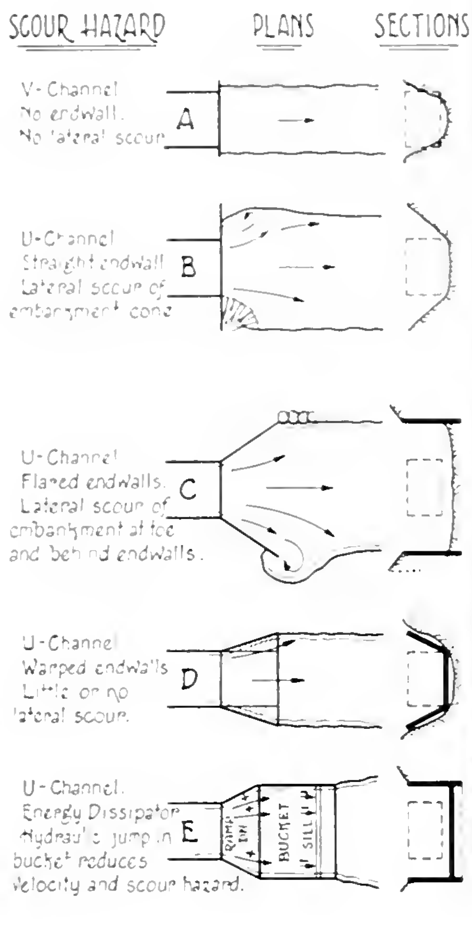


FIG. 32. Influence of transition shape on hazard of lateral scour

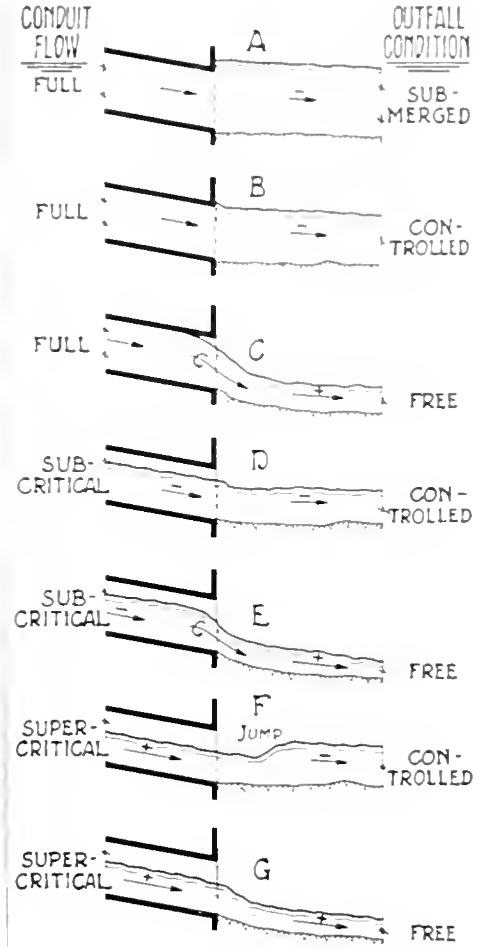


FIG. 29. Typical combinations of conduit flow and get-away

The compensation is not complete because of turbulence, eddies, and boundary friction—amounting ordinarily to 20 per cent of the change in velocity head. In efficient transitions, this can be greatly reduced, but an inefficient transition is more desirable for culverts.

Figure 30 has been drawn as a guide for estimating apron depth and velocity from outlet depth and velocity, the relations depending upon the cubic equation shown. The curves at the left give the depth over the apron for three depths at outlet and the three curves at the right the corresponding velocity. Each set is divided by a line representing critical flow at the culvert outlet. Above this line, all flow is shooting and the curves are reliable. Below, the flow is streaming as it leaves the culvert, contracts to critical flow with little loss of energy, and then becomes shooting. Probably the aggregate loss of energy will be less than assumed, so that velocity will be greater and depth less than indicated by the dashed portion of the curves.

As an example of the use of this guide, suppose that culvert effluent has been computed at 15 feet per second for a depth of 3 feet. Then on the apron (if twice as wide as culvert) velocity will increase to 17.8 feet per second and depth will be only 1.26 feet.

In particular, if the effluent is just critical, the velocity will increase 44.6 per cent. Percentage increase will be more for streaming flow and less for shooting flow. Not shown on the curves but deductible from the same premises is the fact that critical effluents minimize apron velocities. In the example, had the same discharge been streaming, say 5 feet deep at 9 feet per second, apron velocity would have been 16.6 feet per second. But at just critical effluent velocity 11.36 apron velocity would have been 16.4 feet per second.

Free Drop Outfall

As an extreme, the free outfall may be a free drop, as was illustrated **(Figure 12)** for Modified Bottom, Sidefall, and Top Locations, for these the foregoing transition computation is not applicable, of course. The scouring power of free drops is well understood, but experience **(Figure 31a)** has taught that the effluent trajectory must clear the embankment slope by a safe margin or the embankment will slough into the tailwater pool. The critical trajectory will be that for a small discharge.

Also, an ordinary free outfall may become a free drop by degradation of an unstable channel. Even rock sections may be eroded rapidly by boulder-loaded streams accelerated by long culverts **(Figure 31b)**. While it may be economy to add outfall works after such conditions develop, if such a trend be uncertain, it would be prudent to allow for this contingency in cost comparisons of alternative designs.

Controlled Outfall Transitions

Future conditions are most uncertain if the downstream channel

[illegible]

FIG. 31a. Projecting culvert with temporary extension, added after serious loss of embankment

is naturally controlled at some point beyond the right of way line. The control may have been naturally unstable, or a physiographical balance may be upset by the culvert. Such an upset may result from the acceleration of flow, change in channel alignment or grade, or modification of detrital loads.

Since future change is difficult of prediction, it is not sound economy to provide expensive works to guard against all contingencies. However, initial works or maintenance should assure against damaging alteration through property of others, or sudden loss of highway structure or embankment.

Obviously the best assurance is construction of a transition which will discharge the flow **at all stages** just as the former channel did. Granting that such provision is rarely possible or economical, it is a matter of judgment to determine the tolerable departure. As a rule bed scour is less serious than lateral erosion. The former leads to a free outfall **(Figure 31b)** and can be corrected by maintenance betterment of the outlet structure; but lateral erosion may be progressive downstream, so that modification of outlet works can not provide a remedy.

Endwalls Influence Lateral Scour

Endwalls serve the dual purpose of retaining the embankment and limiting the transition. Older designs, such as the straight or flared walls **(Figure 32B, C)** were economical retainers but poor transitions. Use of these below small or submerged outlets is satisfactory but embankment cones at ends of these walls are frequently cut at controlled outlets.

Erosion of embankment toes can usually be traced to eddy action, as sketched. **Figure 33** shows an extreme case, where the angle of flare was too great and transition too short. Severe damage has been recurrent, during floods of less than half the design discharge. At this site, the design discharge was 1,20[illegible] second-feet, anticipating moderate effluent velocity, as outfall channel seemed stable with fair controls and culvert gradient was only 0.8 percent. Prior to 1942, the old-style high wingwalls (see construction joints in photos) were lost and apron was undercut. Although discharge did not exceed 640 second-

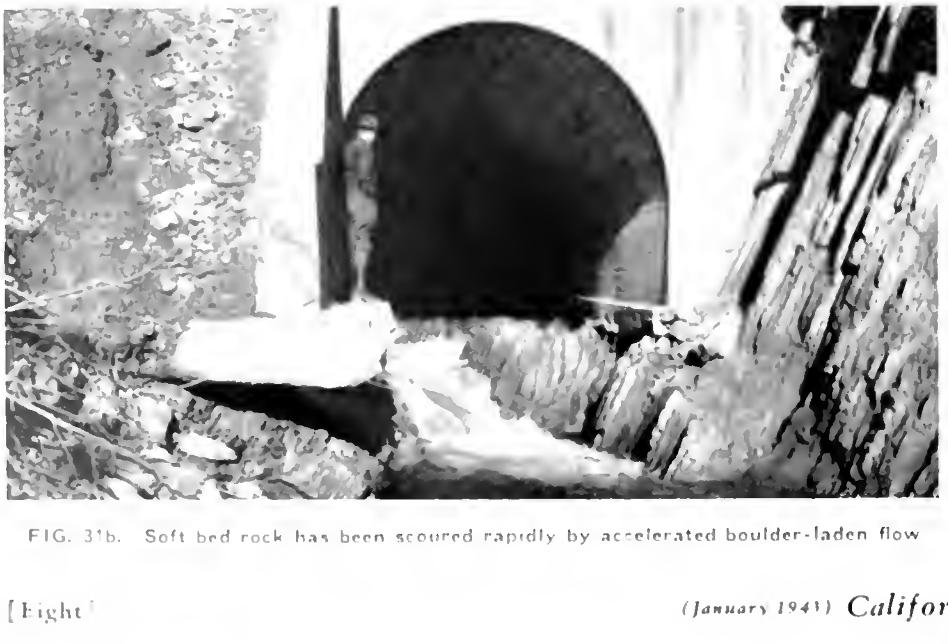


FIG. 31b. Soft bed rock has been scoured rapidly by accelerated boulder-laden flow

feet, effluent velocity reached 11.4 feet per second. The later pictures show further damage to wingwalls, apron, and uncompleted jetties in the 1,000-year storm of 1942, when discharge of 2,000 second-feet created effluent velocity of 18.6 feet per second. At end of apron, velocity probably reached 25 feet per second, producing underscour and powerful lateral eddies.

An ideal transition is a complicated ogee expansion, fitted to the variable momentum, dissipating very little energy. This is not satisfactory for a culvert outlet, where it is advantageous to reduce energy. A flared transition is very effective, if proportioned so that eddies induced by the effluent jet do not

FIG. 33a. Nojoqui Creek culvert in 1940, after discharge of 640 second-feet

FIG. 33b. Nojoqui Creek culvert after 2000 second-feet flood of December 1941

[illegible] velocity.

The [illegible] experimental [illegible] cessful [illegible] (Figure 32E) [illegible] Salt Creek (Figures 35a and [illegible] A free drop [illegible] as a surge [illegible] advantage [illegible] (Figure 36) [illegible]

Cost of [illegible] be reduced [illegible] to the velocity. Figure 37 [illegible] warped wings [illegible] rap [illegible] a bend [illegible] the bend, the riprap [illegible] the outside only, the inside being stable. This transition [illegible]

continue beyond the end of the wing or overtop a sloped wing. As a guide, it is suggested that product of velocity and flare angle should not exceed 150. That is, if effluent velocity is 5 feet per second, each wing may flare at 30 degrees from the thread of the stream; but if velocity is 15 feet per second, the flare should not exceed 10 degrees.

The warped endwall (Figures 32D and 34) has been very successful as a transition, because it releases the flow to a trapezoidal section. Wider use is recommended, especially if the apron must be paved anyway, but it should be designed to greater length and less flare (at top) than similar walls used at culvert entrance. Even for free outlets, there will be little acceleration in this type of transition, so Figure 30

FIG. 34. Construction of warped end wall

developed by progressive maintenance.

Maintenance and Supplemental Design

Such developments are economic. In so many cases, the uncertainty of future channel controls will make a safe design very expensive. Rather than to anticipate the worst possible conditions, the designer may take ordinary precautions to provide a reasonable security.

Subsequently, following a critical test under storm conditions, the design of the outlet works may be revised intelligently and reconstructed by maintenance forces. This procedure should be considered "supplemental design" and is not "maintenance" as defined by the Highway Code. However, the maintenance personnel are the first to discover the damage after floods, and should properly initiate the corrective work.

At such times, patchwork should be the minimum necessary to restore roadway and prevent further damage. Conditions should be studied carefully while evidence of scour is clear. After the study, a report with recommendations should be forwarded to the designer for review, so that a supplemental design may be prepared.

For example, scoured fill cones along banks at outlet may be a warning that a large volume of embankment is threatened. If restoration and protection is confined to the slightly damaged area, the repair may prove temporary. Careful analysis of other evidence of scour might have predicted impending damage to the highway, structure, or downstream property.

Recommendations

Summarizing its findings, the committee recommends generally that:

(1) Unless it can be shown with reasonable assurance that no damage will result, the outfall works should provide a transition for the 100-year flood without freeboard (balanced design), from the culvert outlet to a section in the natural channel where natural stage, width, and velocity will be restored, or nearly so.

(2) If an outfall structure is required for the transition, it will not be a counterpart of that required at the entrance.

FIG. 35a. Bucket outlet deflects Salt Creek through angle of 70

FIG. 35b. Close up of Salt Creek outlet, shooting at 22 feet per second

FIG. 36. Rattlesnake Creek, with drop inside the arch culvert. Note fish ladder at left

FIG. 37. Warped endwall proved too short. Transition extended by supplemental design

(3) The outfall works must be considerate of energy of culvert effluent, get-away and stability of natural channel, and security of bed and banks against scour.

(4) Wingwalls, if intended for an outfall transition, should not flare at an angle (in degrees) greater than 150 divided by the outlet velocity in feet per second.

(5) Warped endwalls can be designed economically to fit trapezoidal or U-shaped channels, as transitions for moderate-to-high velocity (10-18 feet per second).

(6) For extreme velocity (exceeding 18 feet per second) the transition can be shortened by use of an energy-dissipating structure. Design should be guided by observation of experimental structures, such as drops and buckets.

(7) Where future control of outfall is uncertain, the initial design with reasonable security should be modified by progressive supplemental design. Pending review of seasonal damage, repairs should be held to the minimum.

Governor Warren Appoints Purcell Director of Public Works

(Continued from page 2)

United States Bureau of Public Roads, with headquarters in Portland.

In 1920 he was appointed district engineer of the Bureau of Public Roads in charge of District No. 1, embracing Oregon, Washington, Montana, Northern Idaho and Alaska and for seven years supervised the spending of fifty-five million dollars of Federal money on national forest and national park highway and bridge work.

In February, 1928, Mr. Purcell was appointed State Highway Engineer of California and in the 15 years has supervised construction and maintenance work on highways involving the expenditure of $561,000,000.

In addition to this he supervised the construction of the San Francisco-Oakland Bay Bridge, the total cost of which was $73,000,000.

When Mr. Purcell was offered his California post by Governor C. C. Young and Bert B. Meek, then Director of the Department of Public Works, he was told that he would be expected to make a comprehensive report on state-owned toll bridges, including the proposal to bridge San Francisco Bay.

This was greatly to Mr. Purcell's liking. It was right down his alley. It was in line with his dreams. It was to make him the greatest bridge builder of all time.

Mr. Purcell is an associate member of the American Society of Civil Engineers, and a recognized national authority on public highways. He is also a member of the National Executive Committee of Ten of the American Association of State Highway Officials and is a representative of the United States on the Permanent International Commission of the Permanent International Association of Road Congresses.

APPOINTED BY PRESIDENT

In May, 1941, President Roosevelt appointed Mr. Purcell a member of the Interregional Highway Committee of seven men to make a study of post-war development of an improved system of national highways.

Mr. Purcell was appointed a member of a committee of 12 nationally known highway engineering experts by Secretary of Agriculture Henry Wallace in June, 1937, to promote maximum safety and highway utility; official title—Special Committee for the Consideration of Administrative and Design Policies for Highways.

FORMER PRESIDENT A.A.S.H.O.

In November, 1937, Mr. Purcell was appointed Executive Officer, California Commission for the 1939 Golden Gate International Exposition. He served as president of the American Association of State Highway Officials in 1938.

He holds honorary degrees of Doctor of Laws from the University of California; and Doctor of Engineering, University of Nebraska.

MEXICO PLANNING A BIG ROAD PROGRAM

Mexico's Ministry of Communications has announced the biggest road-building program in Mexican history to be undertaken with United States' financial aid in order to facilitate raw material shipments to this country for war production.

A network of hundreds of miles of new roads will be built, linking Mexico's east-west coast and connecting with Arizona and New Mexico. The plans also call for completion of the Pan-American Highway to Guatemala. The program is to be financed by a $30,000,000 United States loan, plus several million dollars which Mexico will receive from the new lend-lease agreement.—*Highways of Happiness Magazine*.

December Survey Shows Gas Rationing Cut Traffic to 65 Per Cent of 1941 Figure

As a result of gasoline and tire rationing, December traffic on California State highways was approximately 65 per cent of the 1941 volume, a survey conducted by the Division of Highways revealed. Gas rationing became effective in this State on December 1st.

This reduction in motor vehicle travel corresponds very closely to the percentage which the Baruch Committee held to be the essential traffic which should be maintained to prevent serious dislocation of the Nation's transportation system.

Californians not only are limiting their driving but also are conforming generally to regulations calling for reduction in speed, the survey revealed.

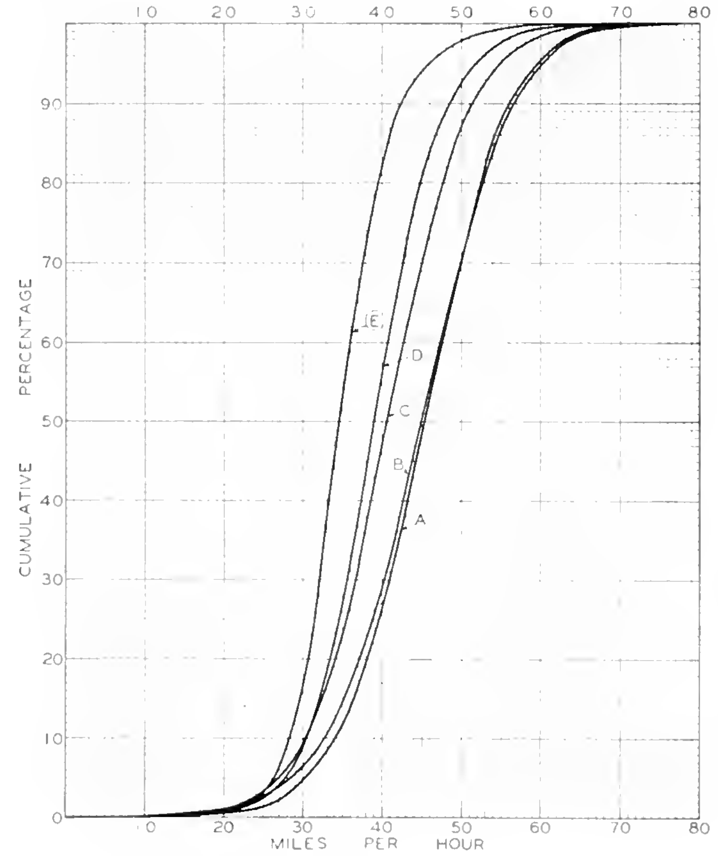
In the June, 1942, issue of this magazine an article entitled "Interesting Trends in Wartime Traffic Shown by Survey" told of changes in highway traffic which had been noted as resulting from our entry into the war.

Accompanying the article were two charts prepared to illustrate graphically these changes with respect both to traffic volume and traffic speeds.

The Traffic and Safety Department of the Division of Highways has for many years conducted traffic counts regularly once each month throughout the year at numerous representative locations covering the entire State, and the results of these counts for the remaining eight months of the current year have now been added to the original chart.

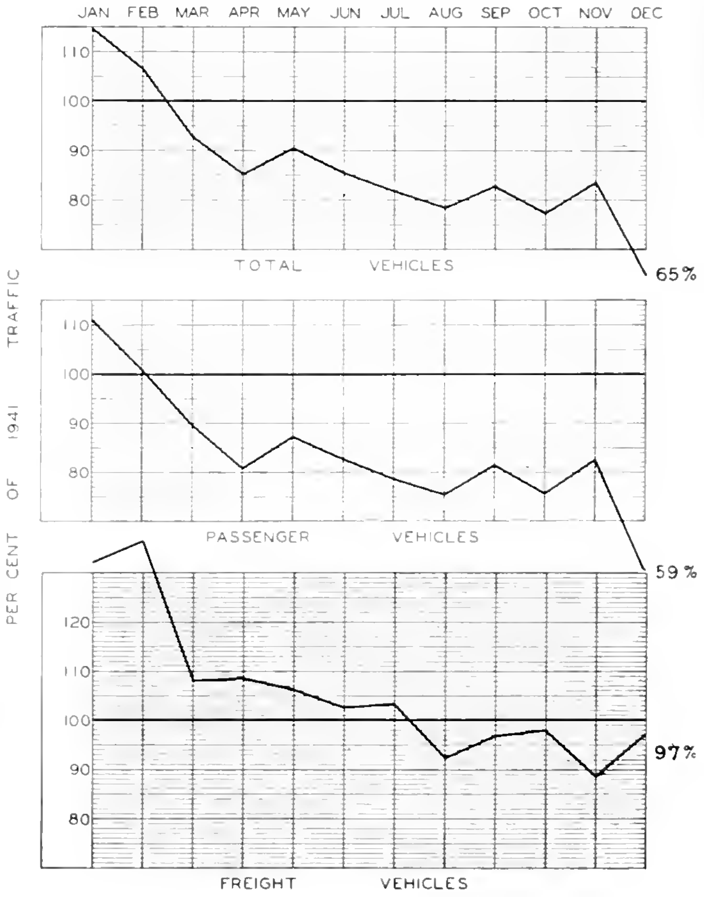
Up until that time such changes as had occurred in traffic speeds were the result of purely voluntary action on the part of the motorists. Later a direct appeal was made by the President that speeds should be kept under 40 miles per hour, and still later, after the issuance of the Baruch report, a universal speed limit of 35 miles per hour was proclaimed.

Checks were taken to determine the reaction of California motorists to each of these requests for further reduction in speed, the first check being made in August and the second in November. The results of these speed surveys, together with the three shown in the original article, are to be found on the present chart in curves "D" and "E" respectively.



	AVERAGE SPEED	CRITICAL SPEED
A PRIOR TO JUNE 1941	47.7	53.8
B NOVEMBER 1941	47.3	54.3
C MAY 1942	43.3	49.2
D AUGUST 1942	39.9	46.3
E NOVEMBER 1942	35.6	40.7

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
TRAFFIC AND SAFETY DEPARTMENT
SPEED CURVES
RURAL STATE HIGHWAY SYSTEM



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
TRAFFIC AND SAFETY DEPARTMENT
1942 TRAFFIC TRENDS
STATE HIGHWAY SYSTEM

Steel Scrap From Old Highway Bridges Salvaged to Build New Structures

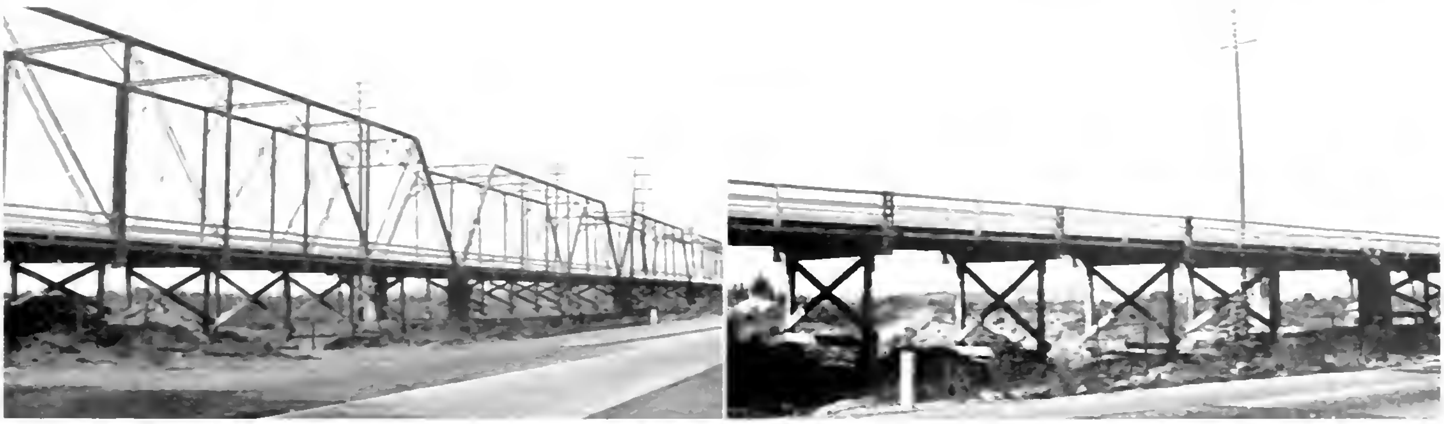
By W. A. DOUGLASS, Senior Highway Engineer

FOR the past 18 or 20 months steel in all forms—structural, reinforcing, bolts, hardware, nails, etc.—has been severely restricted for civilian use. Where normally the Division of Highways would use hundreds of tons each year in the construction and repair of all types of bridges, the work during the past several months necessarily has been restricted to projects of direct benefit to the war effort and those absolutely essential to the maintenance of highway service.

In the manufacture of steel, both iron ore and scrap steel are used. The scrap steel is essential to production of satisfactory new steel. The Government therefore has urged that all scrap which can be spared be turned in for that purpose. **Accordingly, several months ago the State made careful inventory of all stock piles and released the scrap and salvaged steel not scheduled for re(-)use in the near future. In addition, steel trusses which had become obsolete as trusses and were used as trestles, with supplemental bents, were disposed of in order that the steel might go to the mills as scrap.**

An example of this was the steel truss bridge across the old channel of the Santa Maria River in Santa Barbara County. There the portion of the trusses above the floor no longer served a useful purpose on the bridge and was removed to add to the Nation's steel supply.

A large tonnage of scrap steel thus was contributed by the Division of Highways, but probably a more important contribution was effected by the use of salvaged steel where normally large quantities of new steel would have been used. In this regard there was not only a large saving in new steel, but the mill capacities were thus released for production vitally needed by the armed forces.



Before and after views of steel truss bridge across old channel of Santa Maria River in Santa Barbara County from which steel above floor was salvaged.

TIMBER BRIDGES REPLACED

An old timber truss across the Salmon River on the Klamath River Road had served its period of usefulness—had, in fact, failed during the construction of the new bridge. This was replaced by a new truss fabricated of portions of a steel truss just taken down from the Robinson Ferry Bridge across the Eel River. The timber bridge across Bull Creek likewise was on the point of failure, and is now being replaced by a salvaged steel truss.

At the Boat Channel Bridge on the Harbor Drive project in San Diego, structural steel was salvaged from an abandoned bridge in that city, thus avoiding the use of many tons of new steel.

A similar idea was followed in preparing plans for the Casmalia and Schuman separations on the road from Santa Maria to Camp Cooke in Santa Barbara County. In this case, arrangements have been made to purchase a number of plate girders owned by the Western Pacific Railroad but unused for a number of years. From these girders the longer spans required in the new structures will be fabricated to the required length.

WIDENING PROJECT POSSIBLE

The urgently needed widening of Washington Underpass at the western entrance to Sacramento also may be made possible by use of salvaged girders from an abandoned railroad bridge near Port Chicago.

On the State Highway System are a number of steel truss bridges designed and built, in most cases, by other agencies before present heavy truck traffic became general. While these trusses are in good condition and serviceable for many years, they are too light to carry full legal loads, and frequently this condition restricts the service on many miles of

At left, old Salmon River Bridge at Somesbar, Siskiyou County. At right, how it looks rebuilt with steel salvaged from Eel River bridge at Scotia.

highway. At present, many of the secondary roads have become very important due to the development of minerals necessary to production of arms and munitions.

One example is a State Route, west of Red Bluff, which serves large deposits and a number of sawmills. Four light steel trusses on this route are to be strengthened by the addition of salvaged steel plates to permit hauling full legal loads.

To further avoid the absorption of large quantities of vital steel production, a number of steps have been taken. For instance, plans have been developed and are now in use for mass concrete arch culverts in lieu of the usual reinforced concrete design. Likewise mass concrete abutments for bridges are now commonly used.

The State is also using scrap railroad rail of the lighter sections not in demand as rail. These rails are used either full section, split, or rerolled into reinforcing steel. Although the slightly higher cost does not make use of these rails for reinforcing steel attractive in normal times, it is felt the huge saving in steel mill capacity is worth the additional effort.

Furthermore, tests have indicated that the steel rerolled from these rails is uniformly higher in yield point and ultimate strength, which justifies a higher working stress in the design. This higher stress tends to offset any additional cost involved. Also, higher stresses are used wherever possible for structural and intermediate grade reinforcing steel in order to reduce to a minimum the use of new steel. The Bridge Department has been constantly on the look-out for salvaged steel which could be substituted to avoid use of new steel. In fact, a State-wide survey has been conducted, during which a considerable number of steel spans have been located.

Some of these were used directly in State-designed projects; others were made available to the Federal Government for use on the Alaska Highway.

The State has been making every effort to reduce to an absolute minimum the use of critical materials on highway projects. Until normal conditions again prevail, our engineers will exercise all their ingenuity and resourcefulness in building and maintaining bridges essential to the national war effort.

War Department Praises Porter Runway Report

A REPORT by O. J. Porter, Senior Physical Testing Engineer, of the Division of Highways, on the Stockton Runway Test Section having to do with the California method of determining the relative bearing value of soil and its application to design of highways and air field runways has called forth high praise from the War Department.

In a letter to State Highway Engineer C. H. Purcell, Col. James R. Stratton, Corps of Engineers, War Department, says concerning the Porter report:

"This is an excellent report and it is anticipated that the information contained therein will be of great value to the department. It is desired, therefore, that arrangements be made for printing the report for distribution to the department and other interested agencies at an early date. It is estimated that approximately 500 copies will be required."

Porter's report described in the May, 1942, California Highways and Public Works issue dealt with various types of subgrade failures on highways and airports. A comparison was made between highway and runway service requirements, including intensity and repetition of loads, influence of dynamic reactions of trucks and planes, and the effect of these factors on pavement and subgrade design.

Representatives of the United States Army Engineer offices from many sections of the country attended a lecture course and conference on these subjects in Sacramento last April 6-10. During their session, the Army Engineers inspected the runway test pavement at the Stockton air field, and attended courses of instructions at the State Materials and Research Laboratory of the Division of Highways. The exploration of soil deposits by hand boring methods, including soil augers and the California type soil sampler, were demonstrated.

At that time much interest was evinced by the Army Engineers in the electrical equipment developed by the

(Continued on page 20)

Ending Hazardous Situation on U. S. 99 North of Bakersfield

CONSTRUCTION is under way to relieve a hazardous traffic situation on a section of U. S. 99 north of Bakersfield in Kern County.

Due to the building and operation of Minter Field, traffic on this portion of U. S. 99 has increased to such an extent that the present two-lane road is carrying a load 30 per cent in excess of its practical capacity.

A contract has been awarded to the Union Paving Company of San Francisco for grading and paving with Portland cement concrete, four and nine-tenths (4.9) miles of this highway. The project extends from Snow Road to a point 2½ miles south of Shafter Road. Priority ratings have been granted by the Federal Government.

The work will consist of grading and placing a 23-foot pavement parallel to the existing highway, but entirely separated from it. Upon completion of the work a four-lane divided highway will be the result.

The newly constructed roadway and pavement will carry northbound traffic while the existing two-lane highway will carry southbound traffic only. The two traveled ways will be separated by a strip 12 feet wide. The row of trees along the easterly side of the existing highway, whose branches have been allowed to grow close to the ground, will serve as a screen between north and southbound vehicles. Drivers will be relieved of headlight glare along this stretch of highway.

The contract as awarded does not provide for the proposed construction to be extended as far north as Minter Field. However, the Highway Commission, appreciating the need for extending the proposed four-lane divided highway, voted additional funds for this purpose.

Priority ratings have been requested for the two and one-half mile extension to Shafter Road, where a large volume of traffic leaves U. S. 99 to enter Minter Field.

1—Looking North along center line of proposed new 4-lane divided highway North of Bakersfield. 2—Present State highway will become southbound roadways of new highway. 3—Existing trees will form a screen between the two roadways. 4—Trees on right have been permitted to grow down to ground to form screen.

Section of 4-lane divided highway through Buena Park on State Highway 171 in Orange County.

Orange County Highway Is Realigned

By A. N. GEORGE, District Construction Engineer

ROUTE 171 in Orange County makes a straight north and south connection between Route 171 a[illegible] Route 60. Passing through one town, Buena Park, this route serves as one of the [illegible] routes between Los Angeles and San Diego and is [illegible] heavy traffic.

A[illegible] of this route has been carried [illegible] further [illegible] a [illegible] on a narrow [illegible] highway at this point [illegible] holidays.

The [illegible] condition of the [illegible] and the interference [illegible] the entrance to this roadside [illegible] has been corrected by constructing a diagonal connection between the portion of the road north of Lincoln Avenue and south of Lincoln Avenue.

The improvement consisted of a divided highway providing two roadways each with 23 feet of surface [illegible] separated by approximately 30 feet of graded unsurfaced area. Where the new work follows the old [illegible] of shade trees was preserved in the center dividing strip. [illegible] consisted of 6 inches [illegible] cement treated base 25 feet wide, [illegible] was placed 3 inches of [illegible] surfacing.

Bituminous surface treated shoulders were provided on each strip, the [illegible] shoulder being 3 feet wide and the outer shoulder 7 feet.

As this improvement was constructed [illegible] an area of almost level ground which has rather poor drainage, the new highway was raised above the existing ground by means of imported borrow. The source for this imported borrow was a settling basin in the Orange County Flood Control system and the material was a sand with very little binder.

The same material was used for the cement treated base except that some very fine sand which carried a high percentage of minus 200 was added to the mix. This material, together with 20 per cent of commercial gravel, was mixed in a pug mill and hauled to the grade.

The lack of binder in the imported borrow made it impossible to maintain a subgrade under the trucking necessary to transport the cement treated material to the subgrade. Stabilizing it with water proved ineffective so an expedient was resorted to of mixing 3 pounds of cement to the square foot into the top 6 inches of this subgrade.

At top—View of realigned portion of State Highway Route [illegible] a[illegible]ding a congested intersect[illegible] [illegible] [illegible]tected by [illegible] triangular traffic island. At bottom—View of 4-lane section through orange orchards

Report Tells Many Changes in Highway Activities Caused by War

(Continued from page 3)

value of more than $5,000, were limited to access roads and projects on the Strategic Network certified for construction, maintenance work, and projects off the Strategic Network which are individually approved by Federal authorities as essential to the war effort. In addition to this order, use of practically all construction materials is curtailed by the priority system and highway improvement and maintenance is further restricted by orders M-208 and L-218 limiting lumber and by Office of Defense Transportation Recommendation 45-A on asphaltic products.

"The result of these orders to the highway program has been the indefinite deferment of many projects remaining in the current State Highway budget which, while desirable for civilian highway use, can not be justified at a time when the entire resources of the Nation must be used for the prosecution of the war.

"It is anticipated, however, that construction and improvement necessary to provide for the heavy traffic on many California routes resulting from war activities will require greater expenditures than the rapidly shrinking State highway revenue will finance. Reduction of civilian travel induced by the program of rubber conservation and the rationing of gasoline is already being felt in reduced revenue and it is quite apparent that within a few months this reduction will reach some 50 per cent of last year's income.

"In addition to these problems confronting the Department, is the depletion of the Division of Highways staff by personnel leaving to enter military service or to take up work with war industries. During the past biennium over 1,200 employees have left the Division of Highways to join the military forces or war industry."

Concerning the post-war highway program, Mr. Purcell says:

"One phase of highway transportation which is being given consideration at this time is preparation for highway needs after the war. It is highly probable that the social and economic scheme of things at that time will not resemble any of the conditions which this Nation has faced in the past. The adjustment from a war economy to a peace time economy will require some time. Demobilization of the armed forces will flood the Nation with men whose greatest need will be employment. Adjustment of industry from the manufacture of war machines and equipment to production needed for peace time life will release a host of skilled and unskilled civilian labor.

"While all forms of construction will be far behind the needs of the new economy, highway development in particular, will necessitate a rapidity of expansion which will exceed even the demands of the last decade.

"To prepare for this period of transition, the present preparation of a plan of attack is essential. The President has called attention to this present need for preparation and has indicated that he looks to an enlarged public works program as the principal method of dealing with the slump when it comes. The Federal Works Reserve, a unit of the National Resources Planning Board, is now functioning and is cooperating with the several States in building up a list of desirable public works projects to provide work after the cessation of hostilities.

"Highway construction will play a large part in furnishing suitable projects for this reserve shelf of public works. Highway construction provides one of the most flexible opportunities for unemployment relief as it may be varied in type of construction to fit in with varying ratios of available machines and manpower. It may be carried forward and stopped at convenient points and the benefits of the investment immediately realized by the public.

"As a unit of this program, the President has established the Interregional Highway Committee to coordinate the programs developed within the several States so that an adequate interregional highway system will be developed.

"In cooperating with this National plan, the California Division of Highways, along with its wartime construction and maintenance, intends to use its facilities for careful study and planning essential to the proper and economic expenditure of funds for development of adequate transportation needs in the postwar period. Surveys, plans, and specifications for desired improvement will be prepared and, where possible, needed right of way acquired.

(Continued on page 20)

Trucks Play Vital Part in Daily Life of U.S. Citizens

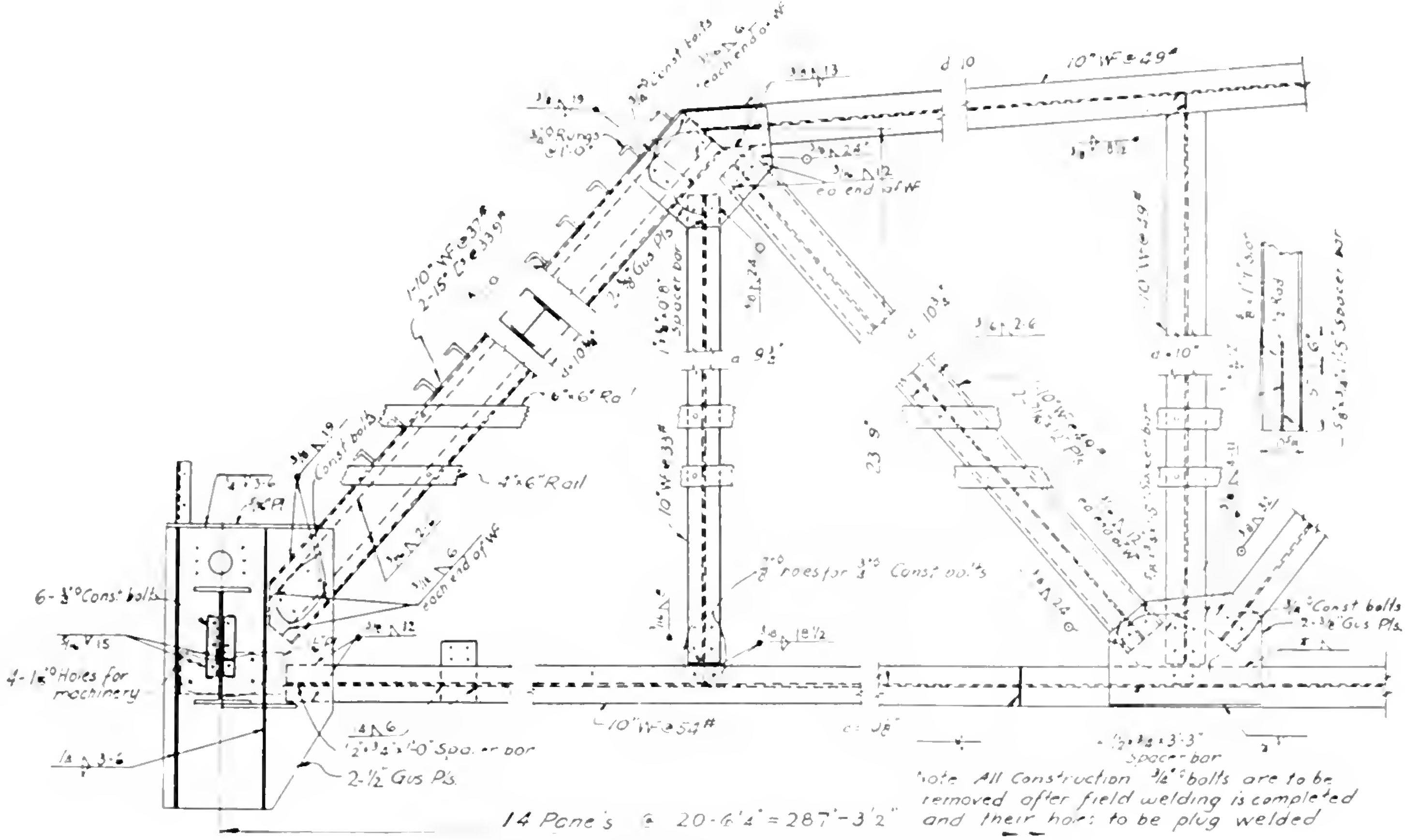
The average American citizen has little opportunity to be familiar with the vital part that highway transportation plays in his daily life. Remove the trucks from the highways and immediately there would be no gasoline, little or no milk, the flow of meat and vegetables would stop. Prices of these and other articles would soar. In spite of our great American railroad system there are 48,000 commodities which must depend on highway transportation alone—and this is one-third of all the communities in the United States. During the year 1940 over 58,000,000,000 ton-miles were carried by trucks on the rural roads of the country.

The network of American highways totals approximately a million and a half miles. Of this mileage about 86 per cent is hard surface.

Of the trucks in the United States about 86 percent are privately owned. About one out of four is farm owned. Engaged in interstate commerce on a "for-hire" basis are approximately 200,000 units, the bulk of which are truck-trailer combinations. In addition to these there are 400,000 other units engaged in interstate, local and intercity commerce.

It is this group of 600,000 trucks and truck-trailers which provides America with a motor transport system that is not only responsible in many ways for our high standard of living but which is now proving itself to be invaluable in the business of war. *Motor Transportation.*

Engineer Again Wins Welding Design Award



Sketch shows a part elevation of an all-welded truss

ANOTHER $200,000 "Industrial Progress Award Program" was held this year by The James F. Lincoln Arc Welding Foundation, similar to the one held in 1938.

The object and purpose of the contest is to encourage and stimulate scientific interest and scientific study, research and education in the development of the arc welding industry through advance in the knowledge of design and practical application of the arc welding process.

The 458 awards were given to persons who by reason of the excellence of their papers upon this subject were selected as most worthy to receive such awards. The scope of the contest covered all fields of industry where arc welding can be applied as a primary process of manufacture, fabrication, or construction of products and structures.

Twelve main classifications were set up, and were further subdivided into 46 divisions. On account of the war, only four countries participated in this year's contest—the United States, Canada, Australia and Ireland. The papers received were judged by a jury composed of engineering authorities from universities and colleges.

In subclassification on "bridges" an award was given to B. M. Shimkin, Associate Bridge Engineer, Division of Highways. In 1938 he received an award from the same organization for a paper on a welded railroad bridge design. This year the prize-winning paper presented the design of an all-welded truss for a swing bridge.

The bridge described is now built, as a riveted structure, across Mokelumne River at Terminous. Arc welding was used to a limited amount in the original design as specified by the American Association of State Highway Officials Specification. Only 483 pounds of electrodes or 2032 feet of 5/16 by 5/16 inch welds were used in this structure. The built-up members and fillers for gusset plates were shop welded and no field welds were used in construction of the present bridge. Mr. Shimkin redesigned this bridge as a full-welded bridge, using the American Welding Society Specification as a guide.

The presence of the draw-rest in a swing bridge creates the most ideal conditions for the erection of a full-welded structure. No shelf angles were used in the all welded structure as all the floor girders, stringers, and other members are supported directly upon the unyielding draw-rest. Assembly starts from center of bridge and symmetrically proceeds to ends which allows a free expansion of welded members and by that minimizes locked-up stresses.

No filler plates are used in full-welded trusses. They are replaced by the spacer bars, which gave simpler details and eliminated ambiguous design for filler plates, and can be seen on the accompanying drawing.

The foregoing indicates that a fully welded structure shows a considerable saving in metal and cost over a conventional riveted bridge.

Broken Glass on Highways Becomes Serious Problem

AN alarming increase in amounts of broken glass and jagged fragments of bottles on main traveled highways, particularly strategic roads in the vicinity of defense plants and army encampments, has aroused in the mind of State Director of Public Works C. H. Purcell a suspicion that deliberate sabotage may be involved.

With the urgent need for conservation of tires, undermanned crews of the Division of Highways are working overtime to meet the new emergency of sweeping glass off the roadways, according to T. H. Dennis, Maintenance Engineer.

Similar deplorable conditions are reported in the San Diego, San Luis Obispo, Monterey and San Francisco Bay Area and other districts.

"The Division of Highways," Purcell said, "is doing everything possible, handicapped as it is by a shortage of manpower, to cope with the situation, but we must have the full cooperation of the Army, Navy, defense plants and the citizens of California.

"It may be necessary to ask the Legislature to increase the penalty for throwing on any street or highway any glass, nails or other substance which might injure tires. Section 601 of the Vehicle Code makes such acts unlawful.

Report Shows Drastic Cut in Highway Works

(Continued from page 18)

"For the two years from July 1, 1940, to June 30, 1942, the mileages, by types of construction, for contracts awarded during that period and the total miles in the State Highway System on June 30, 1942, are shown in the accompanying tabulations, and on the following pages will be found statements and statistics on State highway progress.

"The normal activities of the Division of Highways have been carried on as far as possible, although largely affected and seriously curtailed by war time demands."

Bids and Awards for December, 1942

PLUMAS COUNTY—Near Chester, at a site 0.5 mile southeast of the junction of Routes 29 and 83, crushed and screened gravel to be produced and stockpiled. District II, Route 29, Section A. Contract awarded to Harms Bros., Sacramento, $16,410.

LOS ANGELES COUNTY—Chavez Ravine Road, Coronel St. and connections between Figueroa Street and Lilac Terrace, 0.5 mile, graded and surfaced with plant-mix surface. District VII, Chavez Ravine Road. West & Sommer, Lynwood, $45,085. Contract awarded to Griffith Co., Los Angeles, $39,838.

SAN FRANCISCO COUNTY—Funston Avenue approach to the Golden Gate Bridge, a barbed wire fence to be erected at various locations within the limits of the Presidio of San Francisco. District IV, Route 56, San Francisco. Anchor Post Fence Co. of California, San Francisco, $829. Contract awarded to Cyclone Fence Division (American Steel & Wire Co.), San Francisco, $807.

SAN JOAQUIN COUNTY—Between Kellogg Road and Ludwig Road, about one mile to be graded and bituminous surface treatment to be applied. District X, Chrisman Road. Elmer J. Warner, Stockton, $22,045; M. J. Ruddy & Son, Modesto, $24,655; M. J. B. Construction Co., Stockton, $32,785; A. J. Clausen, Berkeley, $35,267. Contract awarded to Louis Biasotti & Son, Stockton, $21,590.

War Department Praises Porter Runway Report

(Continued from page 14)

Division of Highways for measuring the pavement deflection and subgrade crusher under moving loads and particularly the results obtained on the test section with a heavy bomber, which showed the influence of the dynamic reactions for warm-up and take-off motor speeds.

In forwarding to Purcell the commendation of the War Department, Col. Clay Anderson of the United States Engineer Office, Sacramento, said:

"It is desired to express the appreciation of this office for your cooperation in making Mr. Porter available to conduct the tests and to prepare the report. This office desires to add its commendation of the splendid work rendered by Mr. Porter in this connection."

"Why so out of sorts, Jones?"

"Oh, I've had a very trying day. My office boy tried that old one about wanting the afternoon off to attend his grandmother's funeral and I decided to teach him a lesson, so I said I would go with him."

"Well, was it a good ball game?"

"It wasn't a ball game at all. It was his grandmother's funeral."

Combination Bank Protection on Eel River Constructed

(Continued from page 4)

above the bottom of rock riprap tends to deflect the remaining downward current horizontally into the main body of the stream where it causes no damage.

FLEXIBLE MATTRESS EFFECTIVE

If there is a tendency to scour at the outer edge of the flexible mattress, it is abruptly stopped when the mattress folds into the scoured section. Experience with installations of similar design in California, but of different combinations, indicates that the mattress can fold into scoured sections until hanging almost vertically below the toe of the slope protection. In many cases the mattress is of sufficient weight to prevent underlying material from displacement.

Rock riprap consists of sound rock with a specific gravity of 2.40 in the top portion and 2.28 in the lower portion, ranging in size from $\frac{1}{4}$ ton to 2 tons, chinked with smaller stone.

The length of the slope protection is 820 feet. Rock riprap is 2 feet 9 inches thick normal to the $1\frac{1}{2}$:1 embankment slope for a slope height of 66 feet—9 feet on the slope being below the mattress at stream bed level and 57 feet above.

Heavy key sections built well into the bank are required at the lower end of slope protections of all types, to prevent erosion and destruction of the end from eddy action.

Rock and wire mattress is 6 inches thick and 25 feet wide, consisting of two layers of galvanized wire fencing with a 6 inch rock filling between, laced every 12 inches with 14 gauge galvanized wire into four 6 foot 3 inch by 6 inch cable-connected thin sausages.

The mattress is anchored with $\frac{7}{16}$ inch galvanized cables every 10 feet to log and rail deadmen placed in the embankment. Experience indicates that the upstream end must be anchored to prevent it from curling up.

Scheumann & Johnson completed the contract in November, 1942 under the supervision of A. M. Nash, District Engineer, C. P. Sweet, District Construction Engineer, and Harold Hansen, Resident Engineer.

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CALIFORNIA STATE HIGHWAY SYSTEM

CALIFORNIA
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CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California [PRINTED IN U. S. A.]

C. H. PURCELL, Director GEORGE T. McCOY, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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Vol. 21 FEBRUARY, 1943 No. 2

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Relocation of U. S. 99, Around Shasta Dam Reservoir Site Completed and Opened to Public Traffic

By E. J. BASSETT, District Office Engineer

THE opening to public traffic of the relocated U. S. Highway 99 around Shasta Dam Reservoir on January 8th without fanfare of ceremony or publicity, marked the completion by the United States Bureau of Reclamation of a vast engineering project costing approximately $7,245,000.

The project included the Pit River Bridge, the highest double-deck highway and railroad structure in the world, which was designed and constructed by the U. S. Bureau of Reclamation engineers at an approximate cost of $5,075,000.

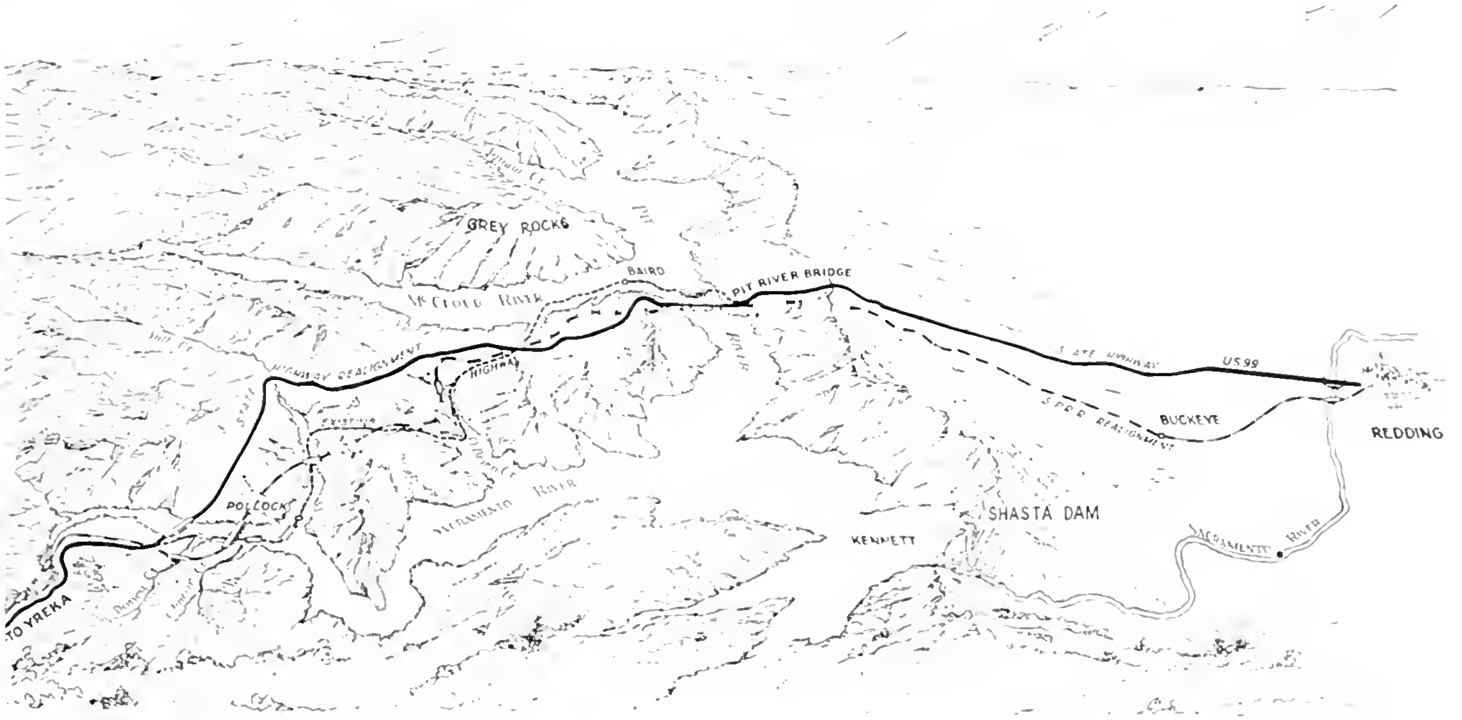
The California Division of Highways located and constructed approximately 15.5 miles of highway, including the Antler Bridge, which was designed by Division of Highways' engineers. The Department of Public Works cooperated with the U. S. Bureau of Reclamation by furnishing a percentage of the cost of relocating a portion of this historic old route, known for decades as the Oregon Trail.

LED TO SACRAMENTO VALLEY

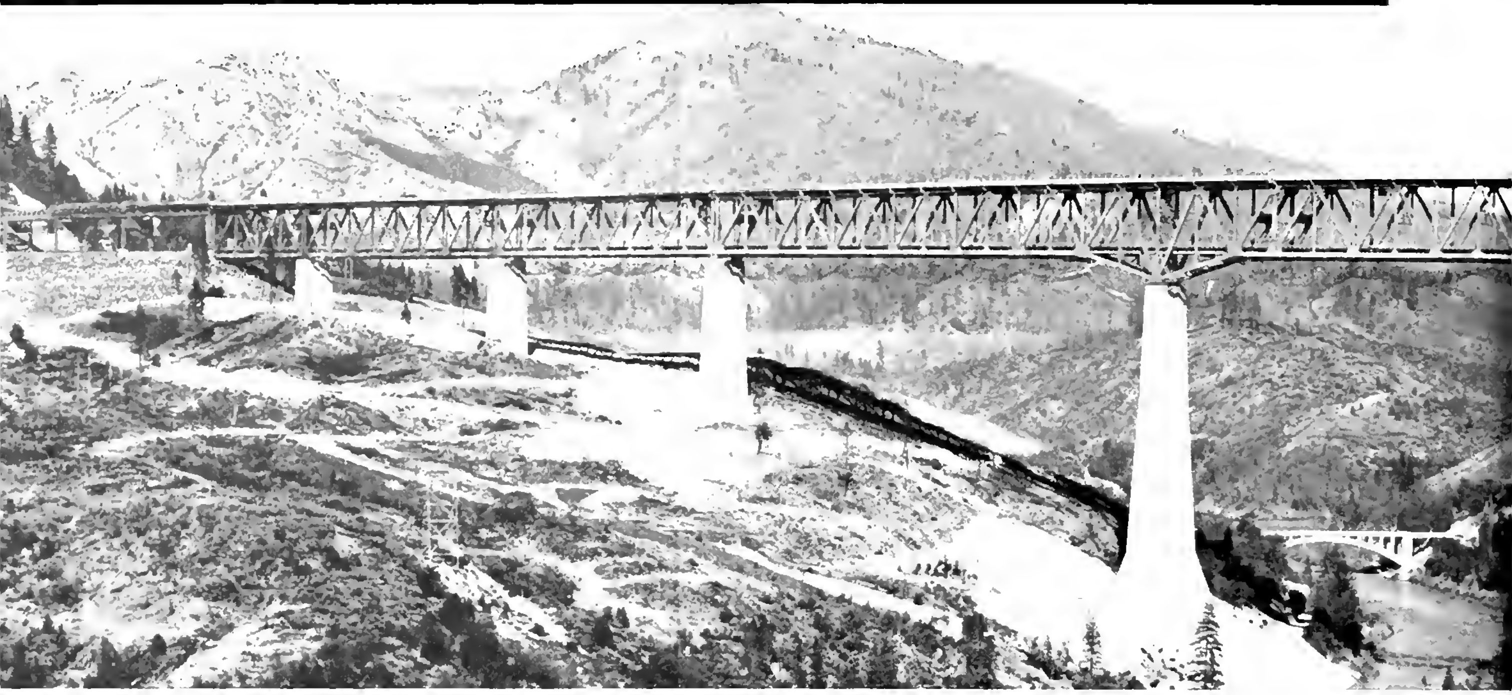
It was used by the pioneers who came over the northern routes to California. They followed the beaten path of the early days which led across the Siskiyous and down through the Sacramento Canyon to Redding, and thence into the Sacramento Valley.

What was once little more than two tracks through the wilderness has been transformed by successive improvements to a modern highway. Its terminals and branches have been extended to embrace a comprehensive transportation system which covers the coastal States and even its name has been changed to the all inclusive designation of Pacific Highway.

And now, on a portion of this route has been built the great Shasta Dam, which will store up the waters of the Sacramento and Pit rivers behind its barriers, waters that will eventually obliterate not only the remaining vestiges of the old overland route but much of the existing highway which spans the area within the confines of the great lake to be. So, to maintain our transportation lines for the requirements of the present and with consideration for future needs, within economic limitations, a new highway has been built through the mountains and across the rivers to replace the pres-



Sketch showing routes of relocated highway and railroad around lake that will be formed by river waters behind Shasta Dam



Photograph of Pit River Bridge, a double-decked structure carrying a railroad on the lower deck and the highway or
350 feet. The exis

ent road which soon will be no longer available for use.

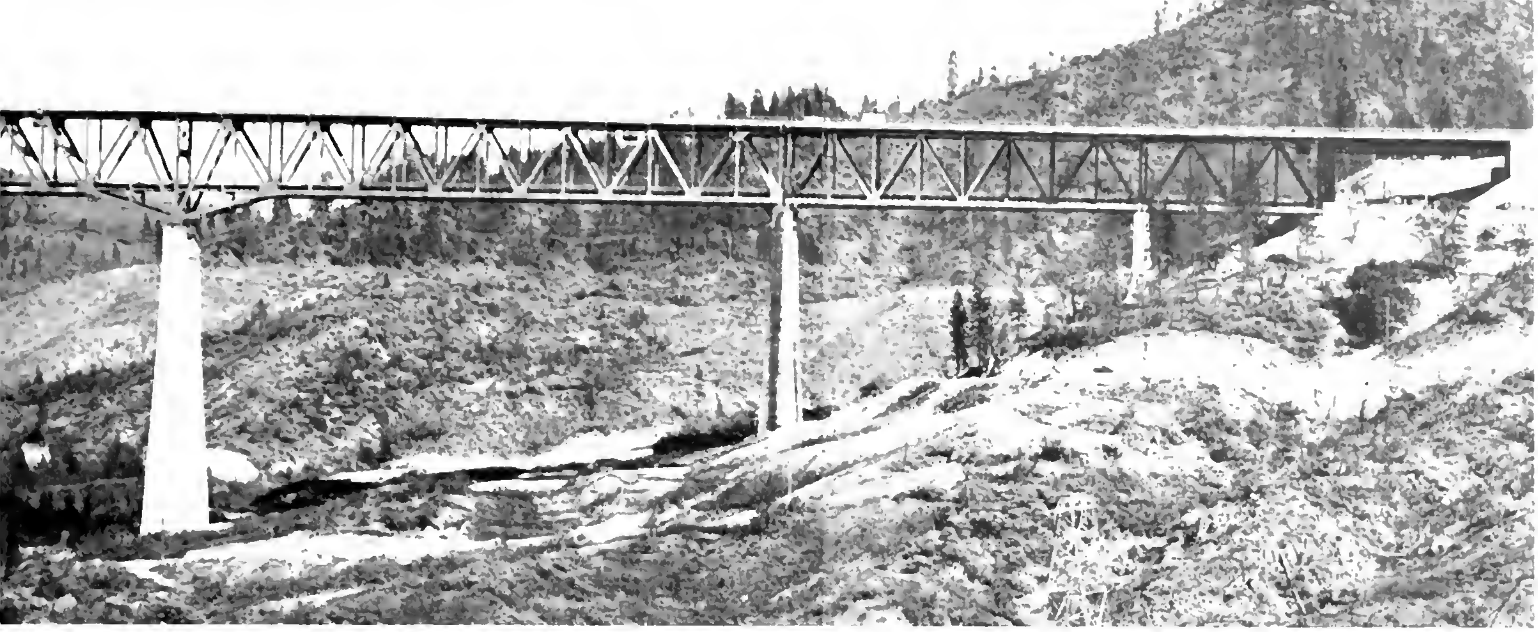
So much has already been printed regarding the technical elements of this great undertaking that little has been left untold. We have read of the massive Pit River Bridge, the highest of its type, with its lower double-track deck for the use of railroad trains and its four-lane highway sitting atop the cantilevered trusses; of the Sacramento River Bridge at Antler, somewhat dwarfed by its big sister on the Pit, but interesting nevertheless because of its complicated design on both vertical and horizontal curves; its hollow piers through which the water may circulate for increased stability to the structure; of the high standard of the highway alignment, with its 700-foot minimum radius of curvature, unequalled in this section of the State and the exceptionally heavy grading through rough, mountainous terrain where excavation quantities on the southerly four miles averaged 344,000 cubic yards per mile.

One of the interesting engineering features of the work, to which little attention has been drawn, is the variety of methods used in developing the five grade separations between the highway and the railroad. Because of the greater flexibility of its alignment and grade, the highway, throughout the greater part of the relocation, was placed at higher and more economical levels than the railroad.

In the early studies of the Pit River Bridge design a single deck to carry both railroad and highway was considered, but, as this involved grade crossings at one or both ends of the bridge, the double-deck type was selected and the question of grade interference removed for all time.

The highway approaches the bridge from the left at its southerly end and departs to the right at the northerly

Relocated section of U. S. 99 around Shasta Dam Lake site near O'Brien Summit, photographed before road was opened



. It is 3,587 feet long and 500 feet above river bed. Two of its piers are the highest concrete piers in the world, exceeding
ge is seen in background

end. The railroad approaches from the left in a tunnel beneath the highway and departs to the left from its own deck, 60 feet below the highway level.

HIGHWAY OVER TUNNELS

Three other grade separations in the southerly four miles of the work were solved by the simple expedient of locating the highway over tunnels through which the railroad passes deep in the bowels of the mountains. These might be termed "naturals," as the surveyed lines fit the configuration of the country to best advantage and did not involve any unusual location problems.

The fifth separation is located near the northerly end of the work, on Antler Flat, where a four-lane underpass typical of such construction is located.

The future has been built into this new highway to a degree consistent with good engineering practice and evident added problems and costs. Realizing the probability of multiple lane requirements at some later time, when the demands of traffic make it necessary and the availability of funds make it possible to widen the graded section, the four major bridge structures were designed and built with these essentials provided for, to avoid subsequent excessive expense.

PROVIDES FOR FUTURE WIDENING

Widening of the graded roadbed and the construction of additional lanes of pavement at some future time will cost no more relatively than at present, and no greater engineering problems will be involved. The widening of the structures would, however, not only entail proportionately greater cost but would present extremely difficult engineering problems, particularly at Pit River where the pier foundations are over 100 feet

(Continued on page 51)

Section of relocated U. S. 99 highway around Shasta Dam Reservoir site near Black Oak Summit before it was opened to traffic

Utilization of Siphon Principles in California Culvert Practice

By G. A. TILTON, Jr., Assistant Construction Engineer
R. ROBINSON ROWE, Assistant Engineer, Bridge Department

FOREWORD

This is the sixth of a series of technical abstracts from a joint departmental review of culvert practice of the California Division of Highways, by a committee composed of Clarence F. Woodin, Assistant Maintenance Engineer; Robert L. Thomas, Assistant Engineer, Surveys and Plans; and the writers.

The utilization of siphon principles in California highway drainage practice is comparatively new, although "sag-pipe" culverts (commonly called inverted siphons) have been used since the inception of the Highway System in 1912.

The purpose of this article is to foster and encourage development and design of siphon culverts and point out practical advantages and adaptations. The committee is of the opinion that the principles involved will be applied frequently if the advantages and techniques are compiled for designers. The subject is treated in detail: definitions, theory, design and application.

IN ancient times, engineers found that gravity-borne water could be led over depressions by pressure conduits connecting their gradetour canals, supplanting more expensive works, such as a circuitous canal or a trestled flume. Unfortunately, engineers were less inventive of words than of works, for such a pressure conduit became known as an "inverted siphon."

Functionally a siphon ceases to be a siphon when inverted, so that the term was self-contradictory. At the time, the true siphon was seldom, if ever, used by civil engineers, so that the expression was reduced to "siphon," a corruption which still persists. Hence, we had two "siphons,"—the true siphon of the wine sampler and the false siphon of the hydraulic engineer.

Subsequently engineers found useful applications of the true siphon,—notably in automatic spillway controls. To erase the conflict, the American Society of Civil Engineers (1)* recommends that false siphons be called "sag pipes." Since culverts may take either form, the Committee conformed to this recommendation, naming and defining several specific types.

Sag Culvert Defined

Generally, the adjective "sag" will be used to qualify a conduit structure or portion thereof for which the flow line is depressed below a uniform grade line. Depending upon its section, the conduit will be designated a "sag pipe," "sag box," or "sag arch," and structures will be called "sag-pipe culverts," etc. When flowing full, the culvert crown will be below the hydraulic grade line, so no vacuum will exist (Fig. 38e).

For simplicity, these terms will not be employed unless the sag is significant in the hydraulics of the structure, either because of pressure on conduit crown or adverse gradient of flow line. Thus, canal flow may pass under a highway through a "sag-box culvert," but a pipe laid on nonuniform gradient in a natural channel may be more appropriately called a "channel-grade pipe culvert."

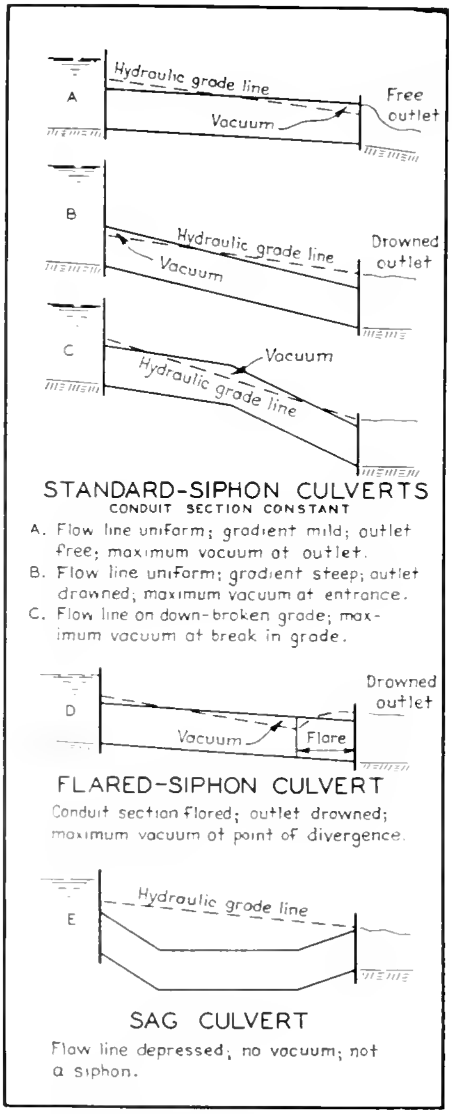


Fig. 38. Classification of siphons and sag culverts

Siphons Classified and Defined

Generally, a siphon is any conduit within which the absolute pressure falls below atmospheric, at some point or at some stage. At such points, the relative pressure is negative and is usually expressed in terms of equivalent "vacuum head." For culverts, the unit of vacuum head is the negative hydrostatic head in feet.

As usually pictured, the siphon has a uniform hydraulic gradient below an elevated crown line, as for the wine sampler. It will be shown that standard culverts can act in this way. If the siphon action is important, functionally, it will be called a "standard-siphon culvert" (Fig. 38a-c).

On the other hand, the siphon may have a depressed hydraulic grade line below a uniform crown line. This is true, substantially, of venturi tubes, pump intakes, draft tubes, etc. Culverts may act in this way if the down-

* Figures in parenthesis refer to bibliography at end of article.

stream end is divergent, which type we have named the "flared-siphon culvert" (Fig. 38d). This, and its most economical form, the "ideal-flared-siphon culvert," will be discussed in detail.

In combination of the two principles, a siphon may have a depressed hydraulic grade line below an elevated crown line, as in the siphon spillway. This combination does not appear to offer any advantage in culvert design.

Sag Culvert Practice

Sag culverts of pipe or box section are used extensively to pass irrigation canals under the highway. Because of the interest of water users in maintaining an efficient section, little difficulty is ever experienced. Design principles are available in many texts, but one point is frequently overlooked.

The initial design usually provides a constricted section under a narrow roadbed, so that hydraulic gradient is much steeper than for the canal as a whole. If the roadbed is widened the culvert must be extended, and the friction in the extension will increase canal stage at the entrance or reduce its capacity.

The change will be greater if the widening is in the form of a divided highway with two sag culverts in series, doubling the entrance and outfall losses of head. In such improvements the designer should provide generous extensions to assure against loss of capacity, using smooth-bore conduit with section 25 to 50 per cent larger than the existing section.

CLEANING COST INVOLVED

Sag culverts are also used to minimize culvert width under low roadbeds, particularly to pass local drainage via tule sloughs. These are reasonably successful, as span is minimized, stagnancy is no worse than in the sloughs, and little silt is borne by such streams. Even where the bed is not paved, tule seldom impairs the waterway.

Standard culverts have become sag culverts because of general aggradation of the streambed. Higher velocities through the culvert tend to maintain a fair section, but many of these are choked each year by material deposited on a falling stage. The cost of cleaning these culverts is an unreasonable maintenance item.

Sag culverts should be avoided on ephemeral or intermittent streams if the consequent stagnation will be objectionable. Short periods of stagnation are tolerable but long periods will be objectionable in many ways.

Standard-Siphon Culverts

Contrary to general belief, a culvert of constant section on a uniform gradient may siphon. The phenomenon was demonstrated by the Iowa Tests (2), particularly (Plate XIX, Tests 213, 291) for smooth bore pipes with submerged entrances and free outfalls. In the latter test, vacuum head on crown of pipe varied uniformly from 0.15 foot at entrance to 0.75 foot at outfall.

No theory has been presented to translate these experiments into design. The possibility of siphoning should be kept in mind whenever estimates of discharge are made from stage observed above a culvert. For example, if the flow of Test 291 had occurred in the field and discharge had been computed on the erroneous premise that the culvert could not siphon, the result would have been 19 per cent under the actual discharge.

SIPHONING CAPACITY UNCERTAIN

If siphoning could be counted on for certain proportions, it would be recommended that the extra capacity be used in design. However, it is doubted that this extra capacity could be depended upon for drift-laden flow. Obviously, if a vacuum forms in a standard culvert with a uniform gradient, the vacuum head must be a maximum at a culvert end (see Fig. 38a, b). The disturbance caused by drift passing that end would permit the admission of air to break or reduce the prime.

If the standard culvert siphons because of a down-broken grade (Fig. 38e), the vacuum head is a maximum at the break in grade, not near an end. Once primed, this type will continue to discharge as if the grade were uniform between end flow lines.

The hydraulics of such a culvert are illustrated by Figure 39. The stage-discharge curve is the broken line OABDE for rising stage and EDCBAO for falling stage. While rising between B and D, the siphon may be partly or wholly primed by air entrainment, reducing the stage relation to some point in the area BDCB: Limiting positions of energy and hydraulic grade lines for one discharge are shown in profile at the right.

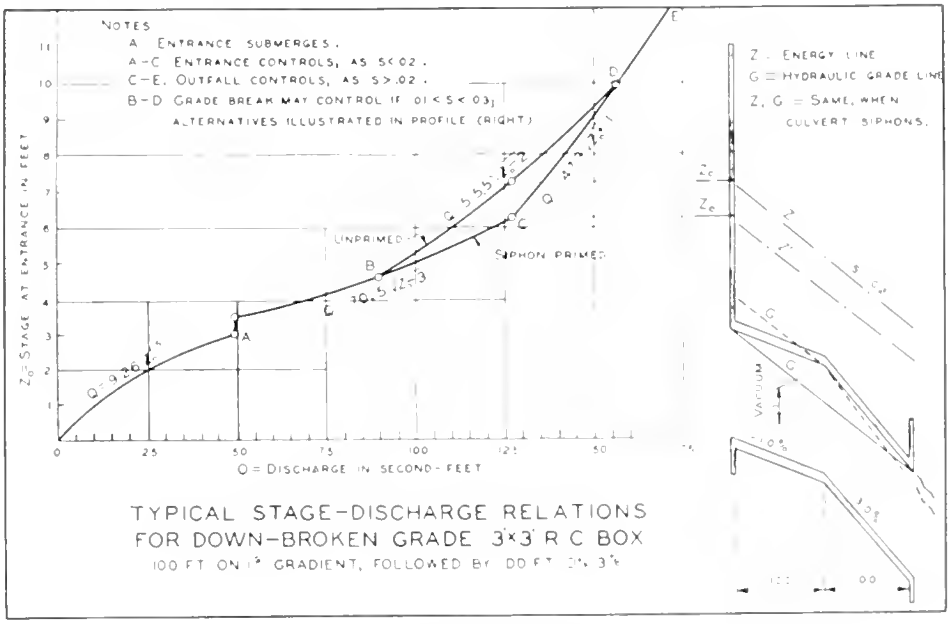


Fig. 39. Hydraulic study of siphoning (Class C) in standard culvert on down-broken grade

Advantage of this design lies in the saving of excavation, and opportunity afforded to adjust the location and grade to insure adequate foundation and outlet conditions. Frequent floods will be carried without increase in stage (below B). Infrequent floods will have a higher stage on the rise but a normal stage on the fall. Peak stage of rare floods (above D) will be unaffected. Since floods are usually quick to rise and slow to fall, the net effect of the grade break is small.

Flared-siphon Culvert

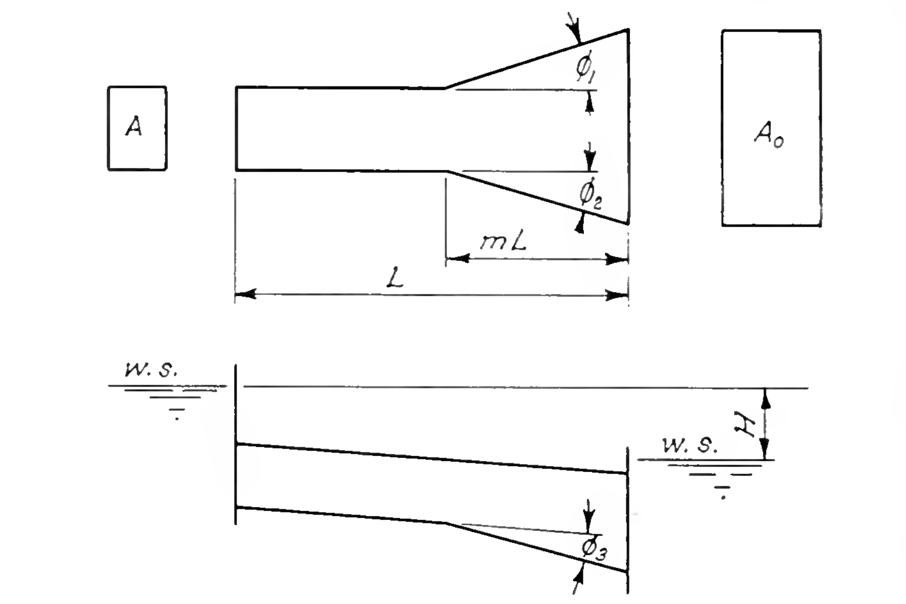
The flared-siphon (Fig. 38d) utilizes the principle of an expanding tube (Venturi) to salvage a large part of the water's kinetic energy. Ordinarily, the sudden enlargement at the outlet wastes 95 per cent or more of the velocity head. This waste is desirable for steep channels, but for cross drainage in broad valleys, the wasted energy is reflected in damaging stages above the culvert entrance.

If the flare is built to diverge on eased curves, little energy will be lost in the transition. The longer the flare and the larger the outlet, the greater the salvage of energy. Thus, if outlet area is doubled, the outfall velocity is halved and kinetic energy wasted at outfall will be quartered. In theory, it is possible to salvage 90, or even 99, per cent of the kinetic energy, but at a large structure cost.

In practice, the flare can be built with flat instead of curved walls and with outlet from 1.5 to 2.0 times the standard section in area, so as to salvage 60 to 70 per cent of the kinetic energy. For any particular site, the most economical flare dimensions will depend upon local factors,—requiring hydraulic computations. For reference, this most economical design is termed the "ideal flared-siphon."

TESTS SHOW ADVANTAGES

The University of Iowa tests (2) showed the hydraulic advantages of the flared siphon,—quantitatively for particular designs and generally for similar designs. For example, the report stated that capacity of a box culvert 36 feet long could be increased about 60 per cent by flaring the downstream 10 or 12 feet so as to double the outlet area. For the general case, the Committee has prepared a formula (Fig. 40) agreeable to all test data and extended by theoretical considerations. This formula is suitable for design, for the complicated expressions become quite simple when some proportions are determined arbitrarily.



$$Q = \frac{A\sqrt{2gH}}{\sqrt{0.05 + pt(1.3 + 15t)(1 - a^2) + a^2 + \frac{0.0045L}{R^{1.25}}(1 - 0.144mr)}}$$

Where:

$a = A/A_o$, the ratio of areas in sq. ft.

P = Perimeter of standard culvert, ft.

P_f = Perimeter of standard culvert sides which are to flare, ft.

$p = P_f/P$

R, R_o = Hydraulic radii of areas A and A_o

$r = R_o/R$

t = Weighted mean tangent of flare angles ϕ_1, ϕ_2, ϕ_3

Fig. 40. Discharge formula for flare-siphon culvert

Figure 41 is introduced to illustrate the methods of computation. Suppose the 10-year flood had determined the size of standard section as a 2 x 2 box and it was proposed to increase the capacity by flaring to a 4 x 2 section in the last 6 feet of a total length of 30 feet. Then A = 2 x 2 = 4; P = 2 + 2 + 2 + 2 = 8; R = 4/8 = 0.5; L = 30; as in usual formulae.

At the outlet, the hydraulic radius is 0.667, so "r" = 0.667/0.5 = 1.33. Two sides of the box will be flared, so P' = 2 + 2 = 4 + hence p = P'/P = 4/8 = 0.5. Also "a" is the ratio of the areas, 2 x 2/4 x 2 = 0.5; and "m" is the proportion of length to be flared = 6/30 = 0.2.

FLARE FORMULA FACTORS

The flare angle may be complicated for skew culverts or boxes flared on 3 or 4 sides. The top slab should never be flared, for that raises the stage (and discharge) for priming the siphon. Rarely will there be advantage in flaring the bottom slab; if a lower outfall flow line is practical, capacity can be obtained more economically by lowering the flow line to a uniform gradient. In the example, each side wall flares one foot in six, so "t" = 0.167.

Substituting these simple values in the formula, the expression reduces to Q = 34.8 √H, where H is the difference in stage between forebay and tailwater. Without the flare, the relation would be Q = 27.4 √H. Assuming a typical tailwater stage, two stage discharge curves were drawn for comparison of the flared siphon with the uniform section.

At the right of Figure 41 are profiles of the hydraulic grade line and energy line, on which are shown the relative losses in the culvert. The total head "H" has 4 components. The flare design has little or no effect on entrance and friction components. The turbulence loss in the flare can be reduced by lengthening or curving that portion and the loss at outlet "h" depends on area of outlet section. These losses should be visualized by the designer, to avoid disproportionate loss of energy or increase in construction cost.

IDEAL FLARE DESIGN

In any case, the ideal flare-siphon culvert must be designed by cut and try, at least until a wider variety of governing factors have been analyzed. As a guide, the area ratio "a" will vary from 1.5 for moderate velocities to 2.0 for high velocities. The flare-length ratio "m" will vary from 0.1 for long culverts under moderate fills to 0.3 for short culverts under no fill. The flare angle tangent "t" should not exceed 0.2 for moderate velocities or 0.1 for high velocities, or the diverging jet will not wet the outer walls causing a gurgling turbulence as prime is intermittently lost).

Flared Siphon Applications

The flared-siphon culvert is an ideal solution for many drainage problems. The first installation in California is shown diagrammatically in Fig. 42. At this site, an existing culvert had proved inadequate after a rural area had been developed into a residential suburb, crowding a stream of the meadow-overflow type. Economy demanded full capacity without exceeding the damage-incidence stage. The flared siphon proved much cheaper than standard culverts of the same capacity at limiting stage.

The design is experimental in that the flare was applied to a triple box. We hope to observe whether the outer boxes are as efficient as the central box. Fig 43 shows the culvert during construction. In this case the slab over the flare had to carry the same loads as the standard section, which would not be true for a long culvert under a high fill.

The flared siphon should be considered in all widening plans in the broad valley areas, because existing culverts can be so extended as to increase their capacities. Submergence

(Continued on page 2?)

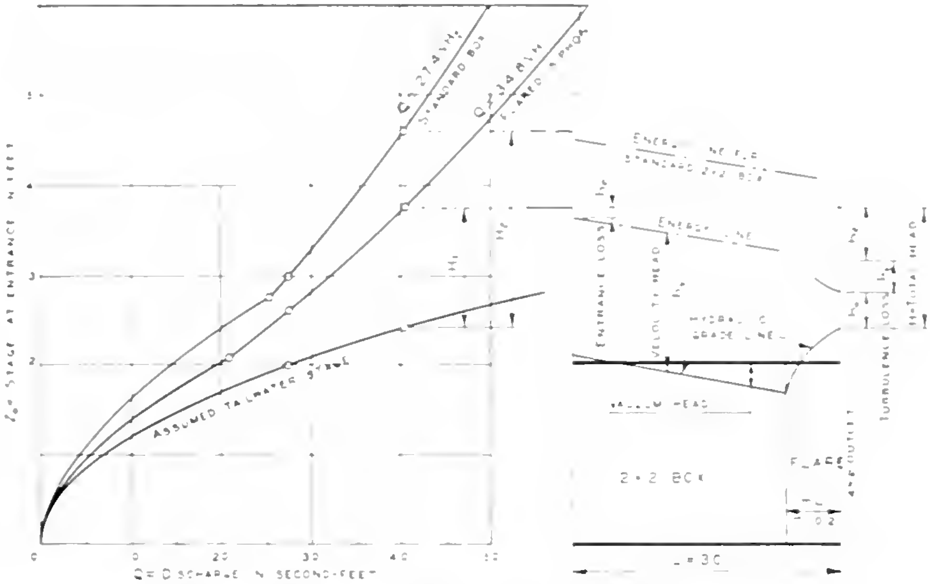


Fig. 41. Hydraulic comparison of flare-siphon with standard culvert

Fig. 43. Vallejo Creek. Construction of flare-siphon culvert

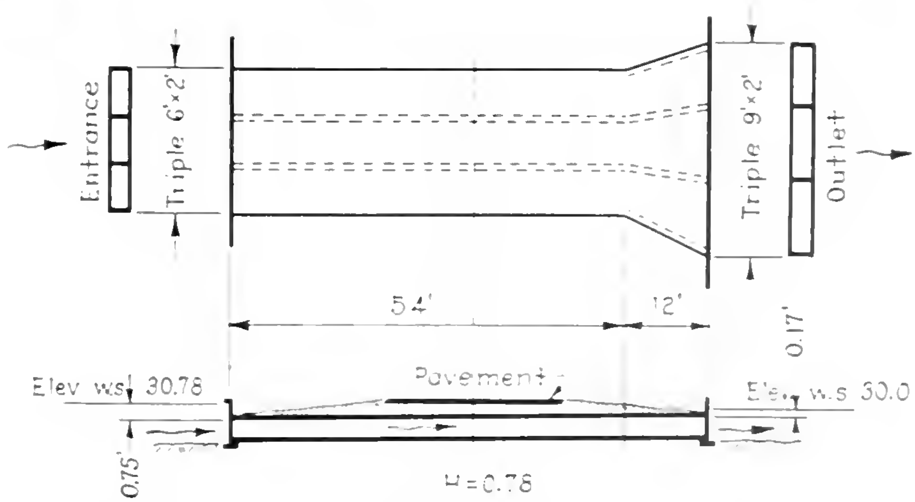


Fig. 42. Layout of experimental Vallejo Creek triple flare-siphon box culvert

Geo. T. McCoy Appointed State Highway Engineer of California

APPOINTMENT of George T. McCoy to be State Highway Engineer was announced January 4th by C. H. Purcell, Director of the Department of Public Works.

After serving 10 years as Assistant State Highway Engineer, McCoy takes the post vacated by Purcell. McCoy came to the California State Highway Department in 1927 as assistant office engineer under R. M. Norton, then State Highway Engineer. He was promoted to Assistant State Highway Engineer when Purcell accepted the job of State Highway Engineer under C. C. Young in 1928.

GEORGE T. McCOY

Born in Oregon in 1889, McCoy was raised on cattle ranches in central Oregon and Washington and from early youth herded cattle and horses on the range. He attended Whitman College in Walla Walla, Washington, and upon graduation completed a graduate course in civil engineering at Columbia University, New York City, paying his way by working in various minor engineering jobs during the summer vacations.

On completing his course at Columbia University, he was employed as assistant engineer on the great Catskill Aqueduct, a $300,000,000 project in New York which brings water from the Catskill Mountains via a tunnel under the Hudson River and down through the eastern part of the State to New York City.

McCoy was engaged on this project in the construction of the Valhalla Dam and several bridges which involved the relocation of many miles of State highway and the removal of a town that were flooded by the reservoir.

Returning to Washington, he became associated with the engineering staff of the United States General Land Office on work in the Cascade Mountains that included an irrigation project near the junction of the Snake and Columbia rivers in 1908 and 1909.

Following this employment, he had 30 years of State highway experience with the United States Bureau of Public Roads and with the States of North Dakota, Idaho, Washington and California.

During six of the 10 years service with the Washington Highway Department, he was Assistant State Highway Engineer.

Pit River Bridge and Highway Opened

(Continued from page 3)

below the ultimate lake level. Construction of the bridges to standards which will meet the exigencies of a coming day was therefore logical and economical.

The last contract to be let provided for the paving of the entire 15.3 miles. During the grading phase of the work very close attention was given to the selection and placing of subgrade material.

Excellent results were obtained with the native shales through which many of the cuts were made, and high bearing values were consistent throughout the work. On this very satisfactory subgrade a pavement was placed consisting of 0.5 foot crusher run base, full width of the roadbed, with 0.2 foot plant-mixed surfacing over the central 22 feet, topped with a plant-mixed nonskid surfacing applied at the rate of 55 pounds per square yard.

Shoulders were surfaced with plantmix tapering to 0.15 foot at the outer edges and sealed with a Class "C-fine" seal coat. At the Southern Pacific underpass at Antler, a section 1,670 feet in length was paved with four lanes of portland cement concrete, with the shoulders treated as above.

Users of the new highway will perhaps never realize the saving of 3.7 miles in distance nor the appreciable reduction in adverse grade over the present road, but the decrease in travel time and the safety features built into the job are factors which the motorist can appreciate. Safe speeds over the present road were found by the Traffic Department to be as low as 25 miles per hour over considerable distances; whereas the design speed on the new construction is 60 miles per hour.

Without ceremony, because of military restrictions, this combination of projects, which has merited publicity because of its contribution to advancements in highway construction, was opened to public use on January 8, 1943. Originally scheduled for completion in early August, to meet the expected flooding of the present road along the Pit, the paving contract, upon which the opening hinged, was delayed because of difficulties engendered by the war. For the same reasons, progress on Shasta Dam was so retarded that the inundation of the old highway was delayed indefinitely, making it unnecessary for the State Division of Highway authorities to vacate the existing road for several months later than was expected.

For detailed descriptions of the grading and bridge construction, refer to California Highways and Public Works, dated November, 1939, January and June, 1940, January, March, April, August, October and December, 1941.

A. H. Henderson Promoted to Assistant Director of Public Works

TWENTY - FOUR years of State service by A. H. Henderson were rewarded when Director of Public Works C. H. Purcell recently appointed him Assistant Director of the Department of Public Works.

Henderson moves up from his civil service post as disbursing officer of the Department of Public Works which consists of the Division of Highways, Division of Architecture and Division of Water Resources.

A native Californian, born in Angels Camp, Calaveras County, on September 1, 1902, Henderson completed his schooling in Sacramento and on January 12, 1918, went to work in the then Department of Motor Vehicles.

From July, 1920, to September, 1932, he was employed in the Department of Engineering and the Division of Architecture. Since 1932 he has been with the Division of Highways, serving five years in the Fresno district office of that agency. He was appointed disbursing officer in January, 1939.

A. H. HENDERSON
Assistant Director of Public Works

Mr. Henderson devoted considerable time and effort to the preparation of a Time Keepers' Manual which established a uniform system of field accounting for the Division of Highways.

Since May 1942, Mr. Henderson has been in charge of car pooling, gas rationing and tire conservation affecting the Division of Highways and various other divisions of the department.

The use of all passenger automobiles of the Division of Highways, Division of Contracts and Rights of Way, San Francisco-Oakland Bay Bridge, Headquarters Shops, and Bridge Department of the Division of Highways has been under his supervision.

He is continuing his duties in this respect as Coordinator of Car Pooling, Gas Rationing and Tire Conservation for the Department.

In this connection he maintains close contact with the Office of Defense Transportation and the Office of Price Administration, acting as liaison officer between these Federal agencies and the Department of Public Works.

Highway Division Car Pool Saves 2,641,912 Miles of Tire Travel

DRASTIC curtailment of passenger car travel in line with tire conservation by the Division of Highways resulted in a saving of 2,641,912 miles during the period from May to December, 1942, Director of Public Works C. H. Purcell reported to Governor Warren.

A careful mileage check on the 715 automobiles operated by the Division of Highways showed that from May of last year, when a tire conservation program was inaugurated by the Division, to December 31, the total number of miles in passenger car travel registered was 5,332,448 as compared with 7,974,360 for the same period in 1941.

This is a decrease in mileage for the eight months' period of 33.13 per cent.

BIG CONSTRUCTION PROGRAM

While the Department of Public Works has had to economize for the sake of rubber conservation necessary to the conduct of the war, the Division of Highways during the last year fulfilled contracts for 142 State highway access road and flight strips at an aggregate cost of $26,353,200, which represents a substantial portion of the $55,420,800 program of construction carried out by the Division of Highways last year, Purcell stated.

These contracts were financed from State highway funds, allocations of Federal Aid funds apportioned to California from Congressional appropriations and from the special Federal appropriations provided by the National Defense Highway Act of 1941 for construction of access roads and of flight strips. In the interest of tire saving, Purcell said, means of transportation other than automobiles have been utilized.

Careful operation, speed limitation, and restrictions of the use of automobiles by travel on trains, buses or other means of transportation during 1943 are expected by State Highway Engineer George T. McCoy to considerably prolong the life of tires and equipment of the Division of Highways' cars and increase the percentage of decreased mileage.

The American Way of life is not just a fine phrase. It is a condition. It is another way of saying, "The rewards of democracy." If you think of all of the comforts, conveniences and luxuries we enjoy in this country, it becomes abundantly clear how tangible these rewards are, and how definitely worth while they are.—*Frederick W. Nichol.*

Rural traffic in 16 gasoline-rationed States dropped 41 per cent during November of 1942 compared with the same month in 1941, state U. S. statistical reports. Massachusetts started 1943 with a decrease of more than 100,000 car registrations. In Michigan, there were 93,452 fewer cars registered.

British Columbia reports that as of November 30, 1942, a decrease of 3,884 cars was shown in the registration ledgers of this province.

Completion of Central Valley Project Urged to Produce Food, Fiber, Rubber

THE first year of war has resulted in many drastic changes in the status of the Central Valley Project. A series of orders issued by the War Production Board has seriously curtailed construction work and postponed, for the time being at least, many of the objectives for which the project was undertaken.

The first and most far-reaching effect of these orders has been to stop work on all irrigation features of the project. Specifically, construction work on the Contra Costa and Madera Canals was halted. No construction can be done on the Delta Cross Channel, the Delta-Mendota Canal or the Friant-Kern Canal. Other orders held up installation of three large power generating units at Shasta and three smaller units at Keswick Dam.

GOVERNOR IS CONCERNED

Meanwhile the budget for the Bureau of Reclamation was sent to Congress with an allocation of only $2,000,000 for this year as compared to some $84,000,000 for last year. The $2,000,000 is sufficient only for administration and some survey work. Last year the bureau budget carried an item of more than $39,000,000 for Central Valley Project construction alone.

The need for appropriations to complete the project as part of the war effort was particularly stressed by Governor Earl Warren at a meeting of the Water Project Authority held January 26th. The Governor said:

"I have been concerned recently about the turn of affairs in connection with the Central Valley Project. I am informed that in all probability there will not be appropriations recommended for the continuation of the work. I hope this is not true. I hope the situation will develop differently because I think this is a time when the project should be pressed from the standpoint of the war effort.

FOOD PROBLEM INVOLVED

"We are talking about the scarcity of food, and I think everybody in California realizes that if things continue the way they are there will be a definite shortage. There is no place in America where food can be produced as it can in California. I think for the project to stand still and not be completed in these times would be a very bad thing, not only for California but for the Nation at large.

"Even when the war is over, the food problem for the world is going to be one of the world's gravest problems if I see the signs of the times right, and I think it is incumbent on us to do everything we possibly can to keep this project going and to keep Washington from believing that it is not a war essential."

The Authority took immediate action by authorizing that representations be made in Washington before the Congress, the War Production Board and other Federal agencies, showing the need for completion of the entire project so it could be operated effectively in all parts of the Central Valley.

LETTER FROM PAGE

A letter from Reclamation Commissioner John C. Page to C. H. Purcell, chairman of the Authority pointed out the need of Authority participation in a series of studies the Bureau of Reclamation has proposed dealing with project problems. One of the immediate problems concerns the order of the construction program to obtain maximum wartime utility.

"From this study," Page wrote, "I look for information and recommendations for a war construction program that will aid in unfreezing cease-construction orders of the War Production Board directed against irrigation and power features of the Central Valley Project."

Previously Page had told a Congressional committee if they would give him a green light he would bring 2,000,000 acres into production in two years and these 2,000,000 acres would be capable of producing foods and fibers in a volume normally obtained from 6,000,000 acres.

In this same connection California is being called upon by Secretary of Agriculture Wickard to produce more food, fiber and rubber as a part of the war effort. The successful growing of guayule in California has been so thoroughly demonstrated, that more and more importance is being given to its production. Completion of the irrigation features of the Central Valley Project would assist materially in providing lands on which the rubber shrub can be grown and additional food supplies produced.

CONSTRUCTION STATUS

At the year end, construction status of the project was as follows:

Friant Dam, which was to serve badly needed water to lands in the southern San Joaquin Valley, was complete except for control gates which must be installed before the dam can be made effective for any of its purposes.

An 8-mile section of the 30-mile long Madera Canal which extends north from Friant Dam is completed but unused. No construction work has been done on the Friant-Kern Canal to Bakersfield.

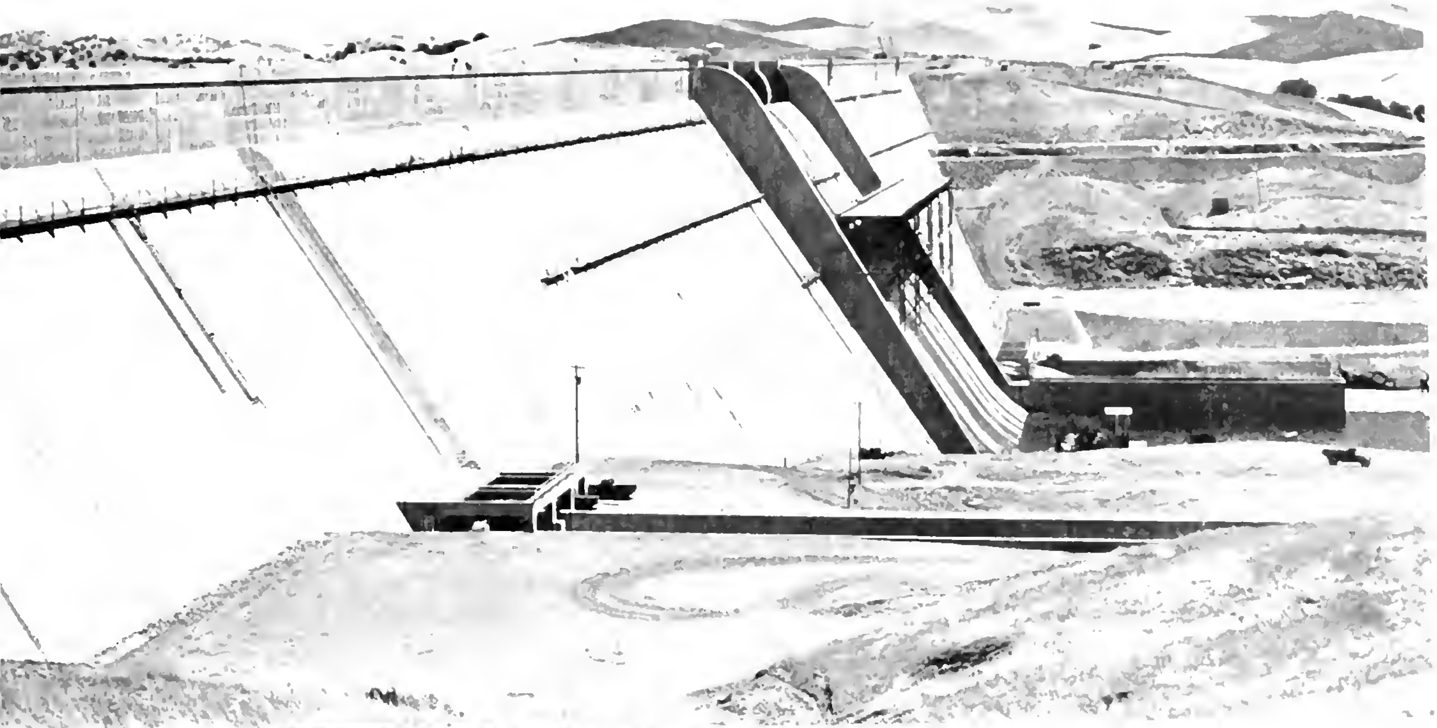
The Contra Costa Canal is completed except for an 11-mile section needed to bring water to Martinez and adjacent areas. It is the only unit of the project in operation at this time. Under a temporary agreement, water is being served to several cities and industries along the south shore of Suisun Bay.

SHASTA DAM

The War Production orders permitted continuation of work on Shasta Dam, and it is anticipated that it will be completed late in 1943 or early in 1944. As of December 10th, the dam was 77 per cent complete in dollar value. Out of a total of 6,000,000 yards of concrete to be poured at Shasta, 4,621,992 cubic yards had been poured on December 10th.

The powerhouse at Shasta was completed during the year and work is under way with the installation of two of the five proposed generating units. Two other units previously

(Continued on page 12)



Top—Friant Dam on the San Joaquin River near Fresno, completed except for control gates. Bottom left: Five months old guayule seedlings in government nursery at Salinas. Bottom right: Machine transplanting guayule seedlings. Below—Planting guayule seed in the government nursery near Salinas.

[illegible]

[illegible] of fresh fruits and vegetables [illegible] outside of the state [illegible] the Central Valley, [illegible] shipped in seasons [illegible] other areas [illegible] the nation are [illegible] producing.

[illegible] maintain this present high [illegible] it is essential that [illegible] Central Valley Project be com[illegible] to remove the hazard of crop [illegible] through lack of adequate water [illegible] due to a dry year or cycle of [illegible] years. Present production has [illegible] because the state has experienced a cycle of wet years during which irrigation reservoirs were filled each winter and there was sufficient rainfall to replenish in part the underground water supplies on which much of the irrigated land in the state now depends.

"The project when completed will [illegible] a greatly needed water supply to more than a million acres of rich developed lands in the San Joaquin Valley and to nearly half a million acres in the delta region which pr[illegible] a wide variety of crops needed to support the military and naval [illegible] and the civilian population.

"Already many food products pro[illegible] in large quantities in the Central Valley are being rationed or withheld from the civilian market. Dried fruits such as apricots, apples, [illegible] pears, prunes, figs, raisins [illegible] are among them. Sugar [illegible] dairy products, meats and [illegible] vegetables [illegible] [illegible] the output has been [illegible] [illegible] use.

[illegible] SHORTAGE

"It is apparent that present [illegible] [illegible] problems of [illegible] shortage is insufficient [illegible] [illegible] needs. Secretary of [illegible] [illegible] on November [illegible] 1943 farm produc[illegible] the largest [illegible] If this program is [illegible] [illegible] as are to be [illegible] Central Valley will [illegible] [illegible] [illegible] water supply [illegible] [illegible] to be developed. With the [illegible] the heavy construc[illegible] Central Valley Project [illegible]

[illegible] new production and protect those which now are producing, provides the only immediate solution of the problem.

"In addition to the present need for additional food supplies, we are faced with the future problem not only of supplying our allies to which we are committed, but of feeding starving populations throughout the world.

INCREASED CROPS POSSIBLE

"No adequate estimate of what will be required from the United States to feed these people is available. It can, however, be safely conjectured that our present production is far from sufficient even with severe restrictions on American food consumption. The lands of the Central Valley of California have the fertility and the climate to produce highly specialized crops with yield per acre under irrigation much greater than the national average. This has been adequately proven by present production. All that is needed to increase this production and protect that which is under way is an additional water supply which can be provided by the Central Valley Project.

"One of the most pressing problems of today is that of transportation. Because raw rubber stocks were not purchased in sufficient quantity to carry on our military and civilian needs prior to the outbreak of war, various steps have been necessary which are seriously hampering our war effort.

"The basis of all these steps, restrictions on speed limits, car pooling, gas rationing, etc., is the lack of adequate raw rubber to keep our nation on wheels.

GUAYULE PLANT PRODUCTION

"Means of overcoming this basic deficiency is at hand and was recognized by the Congress. It is the production of rubber from the desert guayule plant. The Congress has authorized and is undertaking the planting of some 500,000 acres of that shrub. However, experiments carried on in the southwest over the last twenty years have proven that the guayule shrub under modern methods of forced production can only be grown in certain favored areas and on certain types of soil.

"The Federal Government, assisted by State departments, presently is making a survey of all lands in the

[illegible] page 14

Post-war Road Planning Imperative Now Says U. S. Highway Chief

By Thomas MacDonald
Commissioner, U. S. Public Roads Administration, San Francisco, Calif.

Road builders will undoubtedly agree (1) that the release of several million men from the armed forces after the war will tend to create serious unemployment; (2) that a highway public-works program could take up much of the slack in available manpower, and (3) that such application of labor is a constructive way to add to our National wealth.

They know from experience, however, that full-blown plans for such a desirable public-works program can not be produced overnight. They know it takes months of careful planning before construction can be started that will provide employment on any considerable scale.

PLANS MUST BE READY

The opportunity may knock, but it won't wait. If the highway-building industry isn't ready with jobs when the millions of job-seekers arrive, they'll be accommodated in other ways. No highway department, therefore, should be caught unprepared and taken by surprise if detailed plans for post-war highway construction are suddenly demanded as a constructive substitute for "boondoggling."

Detailed advance planning should be in progress now so that the highway departments will be ready to take advantage of every opportunity after the war to modernize this country's system of main highways. Expressly to help finance this detailed planning of post-war highway construction, Federal-aid funds totaling $10,000,000 have been apportioned to the 48 States, the District of Columbia, the Territory of Hawaii and the Island of Puerto Rico under the provisions of the Defense Highway Act of 1941.

LAND PURCHASE ADVISED

In some States, highway revenues may exceed during the war the amount which can be used for highways, due to material and labor shortages and other restrictions on highway work. It is suggested that these States apply their excess funds to supplement their Federal-aid advance-planning apportionment, either for financing additional detailed plans for post-war construction or for acquiring rights-of-way for post-war highway development. Well-planned purchases of land now will provide the most important basis for future application of the advance plans now in preparation.

FOR CITY AND URBAN AREAS

In approval of the advance-planning projects selected by the States, the Public Roads Administration is giving preference to those that will result in plans for wholly adequate facilities for the service of traffic in urban or metropolitan areas as well as in rural sections.

The urban improvements may include city entrance routes, circumferential and distribution routes, and terminal and publicly-owned off-street parking facilities.

The $10,000,000 Federal authorization for advance planning, plus an equal amount of matching State money, provides a fund sizeable enough to project a $500,000,000 post-war highway building program.—*Pacific Road Builder and Engineering Review.*

Fred J. Grumm Promoted to Post of Assistant State Highway Engineer

FRED J. GRUMM

RECOGNITION of 20 years of service with the Division of Highways was accorded to Fred J. Grumm on January 6th, when Director of Public Works C. H. Purcell elevated him from the post of Engineer of Surveys and Plans to the office of Assistant State Highway Engineer, succeeding George T. McCoy, who was promoted to be State Highway Engineer.

Mr. Grumm entered the employ of the State in February, 1922, when he became Assistant Engineer of the California Highway Commission with headquarters in Sacramento. He fulfilled these duties and those of Assistant Division Engineer of Division VI in Fresno until February, 1923, when he returned to Sacramento as Engineer of Surveys and Plans.

A native of Lyons, Iowa, Mr. Grumm completed his schooling in Wisconsin and Michigan and came to California in 1905. He began engineering work on the San Diego Cuyamaca and Eastern Railway in San Diego. From 1908 to 1910 he engaged in subprofessional work on the San Diego and Arizona Railway locations and on the engineering staff of the first San Diego County Highway Commission. In 1910, he was appointed Chief Deputy County Surveyor of San Diego and held that office until 1920, at which time he became Assistant Chief Engineer of the San Diego County Highway Commission, a post he held until January, 1922, when he resigned to enter State service with the Division of State Highways.

Mr. Grumm is a member of the American Society of Civil Engineers, Commonwealth Club, American Road Builders' Association and National Congress Surveying and Mapping.

Central Valley Project Completion an Urgent Need

(Continued from page 12)

State which are adaptable to the production of the guayule shrub. The exact amount of land on which the shrub can be grown has not yet been determined. However, the Department of Agriculture is known to look with great favor on the Central Valley of California and particularly the San Joaquin section of the valley for a large portion of the guayule acreage programmed, contingent upon an adequate water supply. Many thousands of acres now in crops, not vital to the war effort, could be diverted to the production of guayule, and relieve in part the farm labor shortage, if water sufficient for the irrigation of the shrub were provided.

NEED FOR ACREAGE

"The United States Department of Agriculture has on hand and available for transplanting some 300,000,000 guayule plants. To date, however, it has leased only about 35,000 acres of suitable lands for production of the shrub. The department has announced that it will need 180,000 acres under production by next fall.

"Numerous preliminary proposals for providing this additional acreage are under study by the State Division of Water Resources, which carries on all field work for the Water Project Authority. All of these contemplate completion of one or more of the irrigation features of the Central Valley Project, as it is the only project which immediately can supply additional waters to the Central Valley. Completion of the project and extension of its irrigation features to presently unirrigated lands in the Southern San Joaquin Valley would provide sufficient lands to carry out the entire program of guayule planting now contemplated by the Department of Agriculture. With a sufficient water supply these lands are known to be suitable for the growing of the guayule shrub. They have the proper soil, climate and drainage required. A dependable and adequate water supply only is lacking."

A [illegible] town is one where there is no place [illegible] shouldn't.

Five-day Storm Sweeps California Setting New 1943 Isohyetal Lines

A FIVE-DAY storm of major intensity accompanied by high winds caused widespread damage in some sections of California during the latter part of January. Heavy snow reaching to low elevations in northern California checked the runoff on all but the Bear and American rivers so that little damage occurred from flooding in the Sacramento River Basin.

In southern California, particularly in San Bernardino County, extensive damage was caused. It is reported that the damage to public properties alone in that county will total approximately $800,000. No report of the damage to private property has been made as yet. The City of Colton was the most severely affected. The sewer system, city water system and electric system were damaged and debris was left heaped in the streets.

The storm spread over northern California on the night of January 19th. Over the mountain area north of Redding the storm reached blizzard conditions. Snow fell on the floor of the valley as far south as Willows. Due to the snow only medium high stages were reached by the Sacramento River below Redding, the Feather and Yuba rivers and the Sutter and Yolo by-passes.

BLIZZARD AND HEAVY RAINS

Heavy rainfall on the headwaters of the American and Bear rivers caused rises that attained the proportions of flash floods. The American reached a stage which has been exceeded during the period of record only in 1907 and 1928 when large areas in the vicinity of North Sacramento were flooded. Since 1928, levees of the American River Flood Control Project have been extended and North Sacramento protected by a new levee. The project carried the flow without damage to property other than that in unprotected lands subject to overflow.

The value of the recently completed North Sacramento viaduct was fully demonstrated during the high water stage. During six of the past 12 seasons it has been necessary to close the ground level road passing under the tracks of the Sacramento Northern and the Western Pacific, which carried traffic from the north end of the Sixteenth Street bridge over the American River to North Sacramento. This traffic totaled from 25,000 to 30,000 motor vehicles per day.

In the Winter of 1937-1938, the road was closed for a total of 15 days. In the 1939-1940 season, it was closed for 10 days. When this road was closed, traffic was detoured by way of the Jibboom Street bridge at the mouth of the American River and about three miles along a narrow levee road and back into North Sacramento over Arcade Creek bridge.

H STREET DETOUR CLOSED

This route was about three miles longer and during the rush hours of morning and evening traffic the detour added from 30 to 60 minutes to the time required to travel from North Sacramento to Sacramento. Another detour available in the past was by way of the H Street bridge

Storms in January Did $350,000 Damage to State Highways

During the heavy rains of January 20th and 23d, approximately $350,000 worth of storm damage was occasioned on the State Highway System, states Director of Public Works C. H. Purcell. Of this amount $67,000 represents damage to bridge structures.

In the northern section of California the damage was caused by slides and high water. The Maintenance Department of the Division of Highways is engaged in restoration work and the major roads which were temporarily closed have been opened.

"While we anticipated considerable difficulty in obtaining equipment," Purcell said, "we were agreeably surprised at the response made by private operators. We were not so fortunate in hiring necessary labor and as a result the storm damage was handled by our maintenance forces."

over the American River, which was about eight miles longer. The H Street road was flooded during the January storm.

Traffic on U. S. 40 between Sacramento and North Sacramento flowed freely and rapidly over the new viaduct during the entire period of the storm.

ONE LEVEE BROKEN

The Bear River, reaching a stage two feet higher than ever before recorded, broke through a levee in Reclamation District 1001 near Wheatland. Some homes were washed from their foundations and several hundred acres of developed land flooded on the side of the river.

The Division of Water Resources issued warnings to farmers living in lowland areas and those on lands subject to overflow in the Yolo By-pass. On January 23d, four gates of the Sacramento Weir were opened to control a secondary rise in the American River. Liberty Island, Little Holland Tract and Prospect Island in the lower Yolo By-pass were flooded. The Egbert Tract was not inundated.

Flow in the Yolo By-pass at Lisbon reached a maximum of approximately 155,000 second-feet as compared to the maximum flow of 285,000 second-feet on February 8, 1942.

COAST HOMES WRECKED

Damage to public and private property was reported in the north coast area. Extent of the damage has not been determined.

High tides and gales along the southern California coast wrecked numerous beach homes and caused damage to small craft from Alamitos Bay to Santa Monica.

The Los Angeles County Flood Control District functioned, according to an announcement by a district official, "with no damage sustained." Flooding in the Van Nuys and Reseda Districts was attributed to lack of debris or flood control basins in Rubio Canyon.

The storm was not without its benefits, breaking a two-month drought in Southern California and bringing the season's total rainfall to 13.11 inches, nearly double the rainfall for the same period in 1942.

Young wife—"Harold is awful slovenly. Most of the time about half the buttons are missing from his clothes."

Aunt (sternly)—"Perhaps they aren't sewn on properly."

Young wife—"That's just it. He's very careless about his sewing."

Old section of U. S. 40 across American River overflow was flooded but 16th Street Viaduct opened Sept. 14, 1942, carried all traffic

Viaduct 50 feet above ground level, crosses channel and two railroads

Tracks of Sacramento Northern and Western Pacific railroads just escape submergence

Growing on the roadside of the San Jose-Oakland highway are the oldest rows of planted native California sycamore trees in the world.

Group of Rare Old Trees on State Highway Being Preserved

By E. S. WHITAKER, Assistant Highway Landscape Engineer

DIRECTLY north of San Jose, between Berryessa Road and Coyote Creek, scene of early settlement by pioneer families, an unusually interesting island of tree growth has been preserved and is flourishing.

Within a small area now stands one of the three largest specimens of eucalyptus in California, the Capt. Jos. Aram Blue Gum; one of the three or four tallest planted specimens of Sequoia sempervirens, the coast Redwood; a 70-year-old Camellia japonica, probably the oldest Camellia tree in California; a Quercus Suber tree, the cork oak of commercial value, known to have been planted more than 50 years ago.

There is also a row of Ulmus hollandica var. vegeta, the Huntingdon Elm, known to have been large enough in the early 1860's to overhang and shade the road; and two rows of Plantanus racemosa, planted by Chinese labor for the Dr. Townsend estate in the 1860's, these being the oldest rows of native California sycamore trees in the world.

ON MAIN HIGHWAY

The elms and sycamores line a portion of the old road between San Jose and the Mission San Jose de Guadelupe, and are now growing on State highway right of way, bordering a modern 3-lane roadway, portion of the main highway between San Jose and Oakland. In this location, the responsibility of their care and preservation lies with the Division of Highways and more directly with the tree maintenance crew operating under Maintenance Superintendent L. L. Robinson.

Other than an occasional trimming for the removal of heavy overhang and storm breakage, and such routine work as the removal of sucker growth and protection from fire, no beneficial work has been done on these trees. Accordingly, on November 13, 1941, a day labor work order was approved to finance tree reconditioning in District IV, and a portion of this fund was later allotted for work on the elm trees.

All of these tres are in vigorous growing condition and have not been infested with borers or elm leaf beetle, generally the two nemeses of elms in California. However, inspection showed that several large cuts made in the removal of low limbs were showing evidence of heart wood decay, at a number of old stub wound slime flux was present, and on one tree an old traffic wound had become infested with termites.

All of these injuries were on the trunks or main limbs, and it was apparent that early treatment was necessary to prevent further loss of sound wood and a subsequent weakening of the tree structure to a point where collapse would result from wind storms.

As is generally the case when only surface inspection is made and no borings taken to accurately determine the extent of damage by decay, several cavities of large size were opened after work was started showing a long time neglect. The largest cavity measuring 5 feet 9 inches by 2 feet 4 inches resulted from an old 12-inch cut and an untreated bark wound in which termites were working. Both of these injuries covered only an approximate one-quarter of the area of the finished cavity.

The Division of Highways was fortunate in this reconditioning and repair work in having the services of Highway Tree Maintenance Foreman A. E. Burnell, who has a background of over 20 years' experience in tree work in the east and in this State. All stages of the cavity preparation and filling show the workmanship of an intelligent craftsman, and this follows the policy of the Division of Highways in allowing this type of work to be performed only by trained men. Highway Tree Trimmer Leo Simoni, with 10 years' experience with the Division, ably assisted in the work.

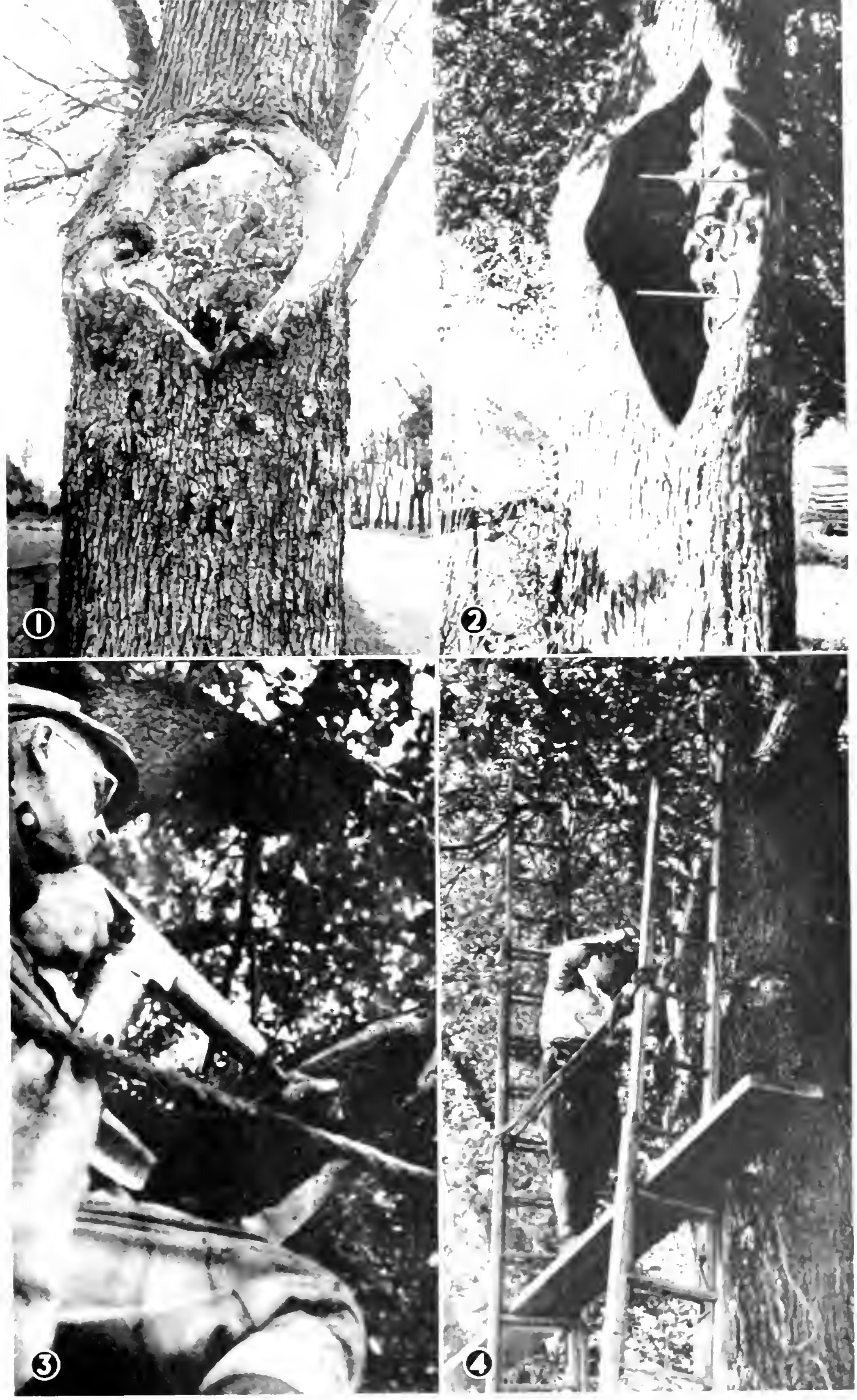
A portion of the cavity preparation was done with electrically operated tools, power being supplied by a small portable gasoline generator of size to operate saws, augers and chisels. These tools were used for roughing out the decayed wood, and the finishing work was done by hand.

DRAIN TUBES INSTALLED

Mechanics of the cavity preparation include the installation of drain tubes in all openings showing signs of heart water, and the placing of lip bolts in all cavities over eight inches in depth and three feet in length.

The trees average 80 feet in height and this, with their spread and location, which is broadside to the prevailing wind flow, make them liable to damage from winds. The wood around an opening of any size in the trunk or main branches is therefore subject to the twisting action of the wind in the crowns, and under undue stress this action may cause severe cracking or splitting of the heart wood known as wind spreading.

The lip bolts when properly placed at right angles to the grain of the



Tree doctors and their work. 1 and 2—Before and after views of elm tree trunk showing decayed heart wood in an old cut, and completed cavity, lip bolts and drain tube in place, ready for sectional concrete filling. 3—Tree Foreman A. E. Burnell, operating an electrically powered chisel for removal of decayed and infected heart wood. 4—Tree Trimmer Leo Simoni shaping a cavity with hand chisel and mallet.

View of unfinished realigned section of Prunedale-Castroville road showing straight tangent eliminating many curves and grade

Short Cut Highway to Coast Improved

THE recently completed section of Sign Route 156, 5.2 miles in length, between Castroville and Route 2 U. S. 101 near Prunedale has opened a more direct route between the San Francisco metropolitan area and the picturesque Monterey Peninsula.

Improvement of the Roosevelt Highway, Sign Route 1, south from Castroville, for a distance of 7 miles, is now under way by current contracts covering the grading and paving with portland cement concrete and the construction of a five span structural steel girder bridge.

Irregularities, circuitous routing and narrow roadbed of the existing road, which was taken into the State Highway System in 1933, were not conducive to travel, resulting in traffic using the longer routes via Salinas or the Santa Cruz highway. With improvement of this section to modern standards, the route using the Prunedale Cutoff will become of growing importance, effecting a saving in distance of 6 miles over the most direct previous route and avoiding the traffic congestion of an intervening population center.

The new location traverses the roll[illegible] of Cienega del Cabilan to the S[illegible] Valley lands bordering the Moro Cojo Slough with fairly large cuts and fills. Alignment is of particularly high standard containing but four curves which have a minimum radius of 2,500 feet. Maximum grade is 5 per cent which occurs on a fairly short section; otherwise the grade is 1 per cent or less. Actual saving in distance over the existing road is 1.9 miles.

The project in general consisted of constructing a reinforced concrete girder overhead structure across the tracks of the Southern Pacific Company, grading a 36-foot roadbed and placing plant-mixed surfacing 22 feet wide x 0.25-foot thick on a crusher run base 21 feet wide x 0.5-foot thick. The low bearing value of the soils encountered in roadway excavation required that a subbase having a minimum thickness of 0.5 foot of imported borrow, with a minimum bearing value of 50 per cent minimum at 0.1 inch penetration on the compacted and soaked specimen, be placed the full width of the roadbed. The 7-foot shoulders were surfaced with imported material and bituminous surface treated.

The approximate major quantities involved consisted of:

Roadway	
Excavation	510,000 cu. yds.
Overhaul	3,000,000 sta. yds.
Imported Borrow	70,000 cu. yds
Crusher Run Base	28,000 tons
Plant-mix Surfacing	14,000 tons
Portland cement concrete (structures)	1,400 cu. yds
Reinforcing Steel	160,000 pounds

SOIL PROBLEMS SOLVED

There are several areas traversec which preliminary soil investigatio disclosed to be composed of saturated unstable peaty material, particularl in the Moro Cojo Slough which is onl 5 feet above sea level, where the un stable material extended to a depth o 22 feet. These areas were stabilized s as to support the proposed embank ments by removing some 25,000 cubi yards of unstable material and back filling the areas with beach sand.

The improvement was let as two con tracts, one covering construction of th overhead structure to Kiss Crane Serv ice, Berkeley, California, and th other covering the road construction t Harms Brothers, Sacramento, Cali fornia.

The total cost of the project was ap proximately $175,000. The residen engineers for the State were G. W Thompson for the overhead structur and F. C. Weigel for the road construc tion.

Two views of realigned and regraded sections of cut-off between U. S. 101 and coast taken before road was opened. Alignment is of high standard containing but 4 curves which have a minimum radius of 2500 feet. The 36 foot roadbed has a 22 foot plant mixed surfacing on a crusher run base and 7 foot shoulders, bituminous surface treated.

Rare Old Trees Being Preserved

(Continued from page 17)

heart wood and considerably in counteracting the effects of wind stress and through their bracing action, assist the tree in overcoming the loss of structural wood.

CONCRETE FILLER USED

Filling material is made of 1 to 3 concrete put in in 8-inch sections, or of size to fit smaller or irregularly shaped cavities. The sections are separated with extra thick tarred fibre paper and the horizontal divisional cracks are sloped slightly out and down, to prevent water from entering the cavity. Fillings placed in this manner afford an over-all strength that, aided by the lip bolts, nearly replace the loss of sound wood destroyed by decay.

The filling is brought to within ½-inch flush with the outer surface of the sap wood and thus provides an even durable surface for the growth of the callus. The concrete is impervious to insect damage or to any nominal destructive action, and so affords a stable wearing surface that only needs a yearly treatment of tree paint to last until it is entirely healed over by the callus.

When correct work is done the decay action is stopped and with complete regrowth of callus the tree resumes a nearly normal growing condition.

The district tree maintenance crews have long been active in corrective trimming and pruning of large roadside trees. It is understood, however, that while many large trees may need and would be benefited by reconditioning and repair work, the cost of such work usually can not be justified.

It is only in instances where trees, such as those described, have a historical value, or are particularly fine specimens, that reconditioning and repair work, including cabling, rod bracing, cavity construction and filling, can be economically justified.

This work above described in District IV provides a basis for consideration of future financing and accomplishment of this type of tree preservation, which will be continued in the future when and where it is determined advisable.

In Memoriam
Henry A. Sellers

The passing of Henry A. Sellers after but a few days of illness came as a shock to his many friends in District VI of the Division of Highways and throughout the State. His death occurred at his home on New Year's Day, following a heart attack.

He was a native of California, having been born in Antioch in 1877. For the past 22 years he had lived in Fresno County.

In February, 1931, Mr. Sellers became affiliated with the Division of Highways in the Right of Way Department at Fresno and for over 10 years served as District Right of Way Agent.

In his earlier years Mr. Sellers served for a period of five years as Engineer with the Pacific Mail Lines on runs to the Orient. Tiring of the sea, he engaged in farming and dairy ventures in the San Joaquin Valley. From 1909 to 1916 he operated a 250-cow dairy at Knightsen, California. During this period he promoted the idea of a Dairyman's Association with the resulting organization of the Central California Creamery in 1914, of which he was the head for the following three years.

In 1920 he disposed of his dairy interests, taking over for the next nine years the active management of the large Hotchkiss holdings in the San Joaquin Valley. He also engaged in cotton and wheat farming in the Firebaugh district.

He leaves his widow, Mrs. Pearl E. Sellers; three sons, Grove Sellers of Fresno, Milton K. Sellers of Walnut Creek, and Henry C. Sellers of Delano. A sister, Mrs. Herbert French of San Francisco, and five grandchildren.

Bids and Awards for January, 1943

SAN DIEGO COUNTY—Between San Luis Rey and Rancho Santa Margarita, about 4.3 miles to be graded and bituminous surface treatment applied. District XI. Denm Investment Corp., Wilmington, $128,388; Griffith Co., Los Angeles, $140,230; J. E. Haddock, Ltd., Pasadena, $175,545; Oswald Bros., Los Angeles, $182,079; Clyde W. Wood, Inc., Los Angeles, $191,191. Contract awarded to Basich Bros., Torrance, $126,301.

SAN MATEO COUNTY—On Butler Road in South San Francisco, about 0.4 mile to be graded and surfaced with plant mixed surfacing on crusher run base. District IV. The Fay Improvement Co., San Francisco, $26,003; Union Paving Co., San Francisco, $26,103; A. J. Clausen, Berkeley, $26,407; Chas. L. Harney, San Francisco, $27,973; California Paving Co., San Mateo, $29,225; Guerin Bros., South San Francisco, $30,165; Peter Sorensen, Redwood City, $31,125. Contract awarded to L. C. Smith, San Mateo, $21,785.

SANTA CLARA COUNTY—On Hendy Avenue and East California Avenue in Sunnyvale, about 0.9 mile to be graded and surfaced with plant mixed surfacing. District IV. A. J. Raisch, San Jose, $38,192; L. C. Smith, San Mateo, $38,698; California Paving Co., San Mateo, $38,932. Contract awarded to Union Paving Co., San Francisco, $37,053.

Siphon Principles in Culvert Practice

(Continued from page 7)

of outlet is a necessary condition, of course; if submergence is not natural, it can be obtained by building a sill or weir on the apron. There is great promise in this design, as otherwise the existing culvert may have to be reconstructed to avoid overtopping. The flare extension can be added without interruption to traffic.

Committee Recommendations

Summarizing the discussion of sag culverts and siphons, the Committee recommends generally that:

1. Use of sag culverts should be restricted to sites where silt load is negligible and stagnation can not be objected to.
2. Sag culverts carrying canal water should not be extended without benefit of an hydraulic analysis of the effect on stage and capacity.
3. Culvert designers should be familiar with the true siphon as an economical drainage device and as a factor affecting estimates of discharge through existing culverts.
4. Standard culverts may be laid on down-broken grades to save excavation costs with assurance that siphoning will partly offset the impairment of grade. Particularly, the critical design stages may be unchanged by the impairment.
5. Flare-siphon culverts can be designed hydraulically by the formulae presented herein.
6. Flare-siphons offer great promise in the solution of cross drainage problems in broad valleys, particularly (a) if moderate stages will cause damage; (b) if roadway grade is low and likely to be overtopped; (c) if existing culverts on narrow roads are to be extended.

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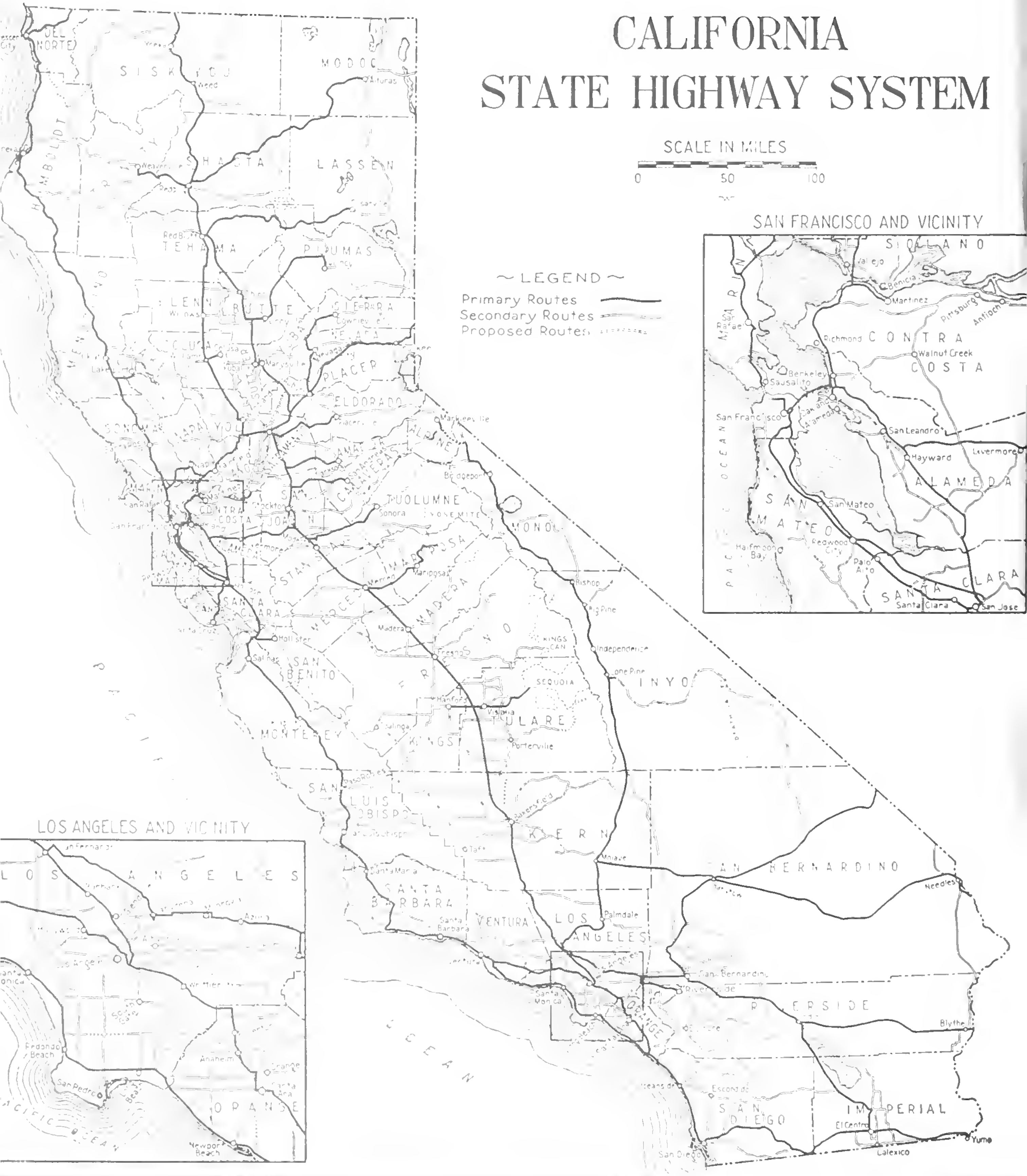

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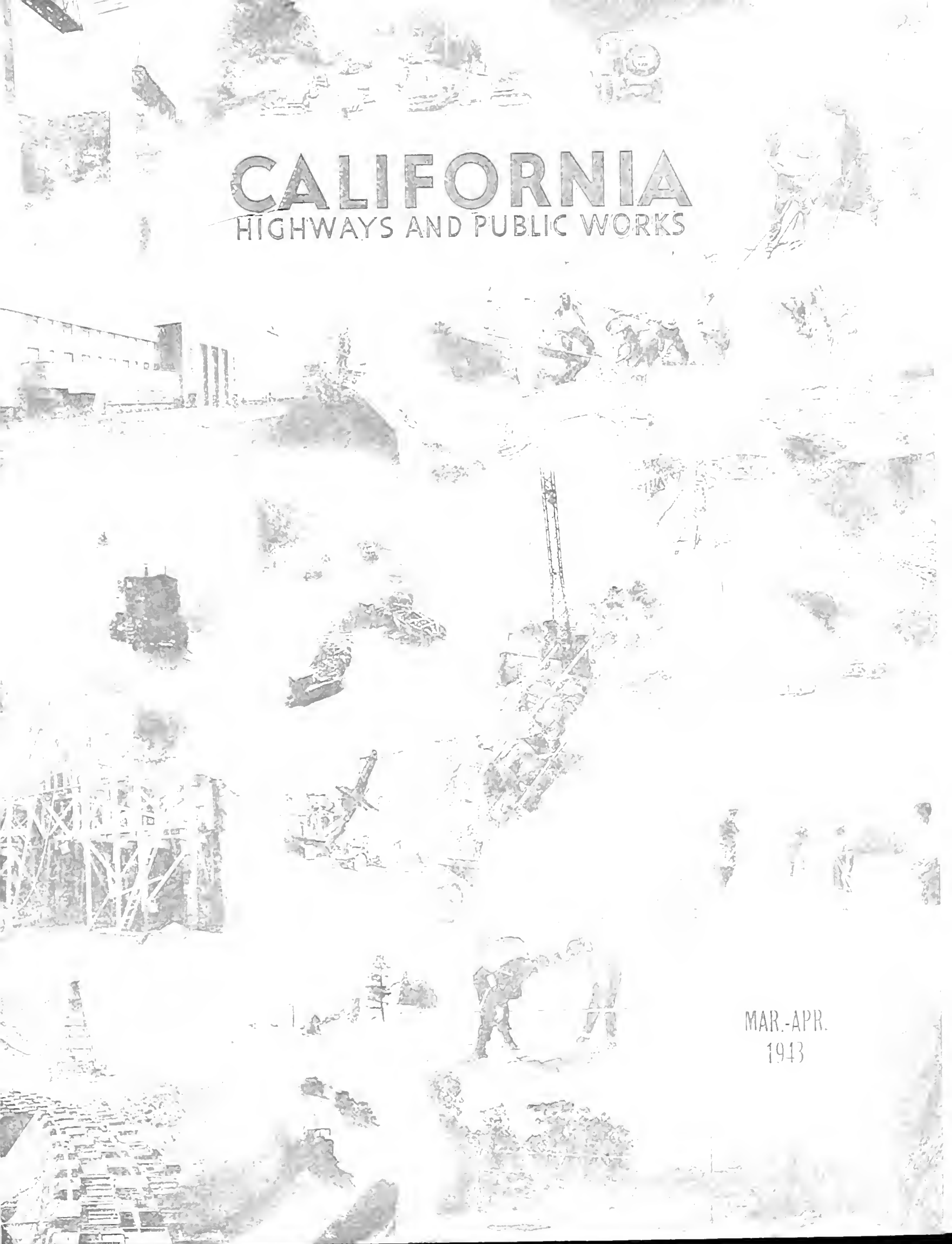

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Grapevine Grade Widened to 4-Lane Highway with Center Safety Barrier and Drainage Features

By E. T. SCOTT, District Engineer

THE State's most hazardous stretch of highway, the Grapevine Grade, on the U. S. Route 9 between Los Angeles and Bakersield, has been widened. Along this six nile length of highway the grade is continuous 6 per cent. While the -lane pavement which existed prior o the widening, would have been adequate, under normal conditions, for he daily traffic of 6,000 vehicles, the lifferential in vehicle speed, because f the grade made this highway secion most hazardous.

Along this most important transportation route which connects the Los Angeles Metropolitan area with he fertile San Joaquin Valley, an normous tonnage of produce is hauled by heavy truck and trailer. Of the normal traffic about 20 per ent are trucks and trailers.

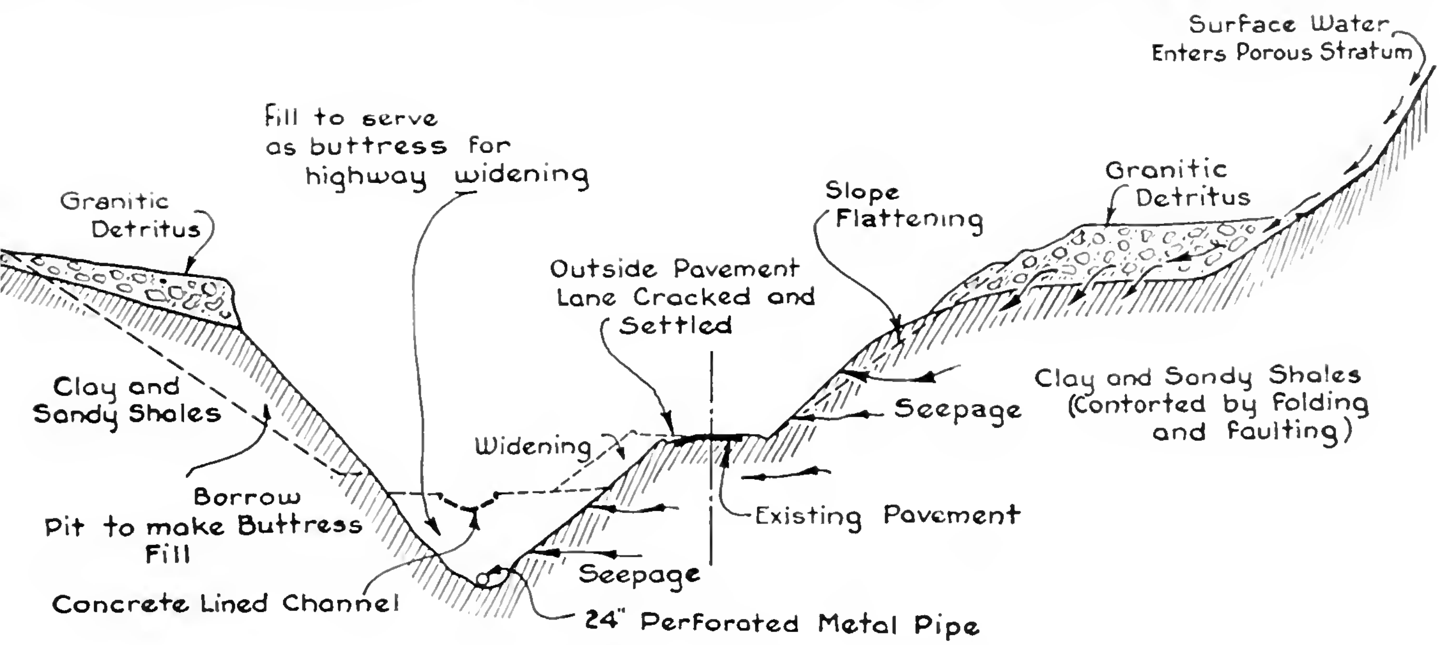
These heavily ladened vehicles are required to travel in a low gear at a very reduced speed while winding down the six miles of 6 per cent grade. The passenger vehicles, not hindered by the grade, continue to travel at high rates of speed, and the approach to the rear end of a slow moving truck has been most sudden.

On the old 3-lane pavement the fast moving passenger vehicle could pass the crawling truck provided the center lane of the pavement was unoccupied. Too often the center lane was occupied by a vehicle moving in the opposite direction. Many rear end collisions resulted, and caused the greater percentage of the fatalities.

Runaway trucks taking up the whole width of the 3-lane pavement on their dash down hill, added to the number of deaths resulting from traffic accidents on this six mile stretch of highway. The appalling toll has been from 10 to 14 killed and many more injured each year for the past few years.

It was necessary to more adequately provide for fast moving passenger vehicles to pass slow moving trucks. This was accomplished by widening the existing 30-foot pavement to 50 feet. The result is a 4-lane divided highway with an 11-foot traveling lane and 12-foot passing lane on both sides of a 4-foot median separator strip which divides the opposing lanes of traffic.

To prevent out-of-control vehicles from crossing to the wrong side of the highway, a steel barrier rail mounted on heavy wooden posts, was



Sketch shows plan of widening and drainage operations in Grapevine Canyon constructed along the 4-foot dividing strip for a distance of nearly four miles. This metal plate road divider consists of 12-inch convex steel rail, mounted by means of spring supports on two sides of a row of 8 by 8 inch wooden posts.

The steel plates as well as the spring supports and other metal accessories were furnished to the contractor by the State. This material had been purchased by the State a long time in advance of the construction work, months before priority was required on this type of material.

Another safety device installed to aid runaway trucks in retarding their speed, consisted of 3,000 lineal feet of heavy curb. This curb is constructed on the outside edge of the 10-foot plant-mix shoulder on the downhill traffic lane. It is a heavy concrete curb with a 15-inch vertical face. During short time the curb has been in place, at least three trucks out of control in varying degrees, have rubbed against it, with successful results. The curb is awfully hard on the sidewalls of tires but it will slow down the vehicle.

The widening of the Grapevine Grade was accomplished under two contracts, the first of which was completed about a year ago. This contract consisted of grading operation, slide stabilization and besides the usual drainage structures, the construction of a buttress fill of approximately 180,000 cubic yards.

A badly saturated hillside from which many slides have come in on the highway and threatened to carry the roadway into the canyon of Grapevine Creek, has been stabilized. The stabilization consisted of two operations. The interception and draining of water from the hillside above the highway and the buttressing of the highway embankment by filling the canyon below the highway.

At various places along the hillside numerous holes were drilled by hydraugers. Starting at a point two or three feet above the highway gutter grade, the holes were drilled from two or three degrees above horizontal to 20 degrees above horizontal in order that any water encountered would flow freely to the highway gutter.

Holes were drilled for various lengths up to 170 feet. Some of the holes were dry but a great many of them intercepted water and the flow from the holes, which were provided with two-inch perforated pipes, ran from a few drops up to 200 gallons per hour.

To prevent the possibility of the creek cutting out this buttress fill, a concrete lined channel with special

(Continued on page 20)

Public Works Effects Big Car Mileage Saving

DURING the months of January and February the Department of Public Works effected a saving of 576,971 vehicle miles of travel by reducing the usage of passenger automobiles under its jurisdiction.

Of this total, the Division of Highways saved 515,906 vehicle miles.

In line with the war program of tire, gasoline and equipment conservation, the department is curtailing automobile travel to the fullest extent consistent with its necessary operational activities. Mileage records of four divisions of the department, were as follows:

	January 1942	January 1943
Highways	841,226	527,710
San Francisco-Oakland Bay Bridge	7,406	3,837
Water Resources	48,733	22,857
Architecture	20,528	9,381
	February 1942	February 1943
Highways	634,687	432,297
San Francisco-Oakland Bay Bridge	6,301	10,258
Water Resources	41,539	21,761
Architecture	14,566	9,906

Section of new 4-lane divided highway in Grapevine Canyon, showing metal plate road divider and concrete flume for creek at left.

View of section of completed highway between Bradley and King City on U. S. 101 via Jolon, original route of El Camino Real

Highway Improvement Completed From Bradley to King City via Jolon

By A. N. LUND, Assistant District Construction Engineer

THE original route of El Camino Real has been reestablished from Bradley to King City via Jolon during the past year by the construction of 40 miles of highway.

Beginning near Hames Creek Bridge on U. S. 101 about two and one-half miles north of Bradley, the new highway follows generally the existing county road but with standard alignment and grade, for about 22 miles in a northwesterly direction to Jolon, thence northerly 18 miles to a junction with U. S. 101 on the west

[illegible]

Section of Bradley-King City highway showing concrete check dams along creek channel to prevent excessive erosion in canyon section

six miles north of Jolon, a length of nine and one-half miles, was undertaken by the Work Projects Administration in May, 1941. The balance of the project was contracted in units of 5.9, 13.1, 3.9 and 5.8 miles in length and contracts were awarded to Louis Biasotti & Son, N. M. Ball Sons, Brown, Doke and Baun and Basich Bros., respectively. Work was begun in 1942.

Operations by Work Projects Administration forces continued through the remainder of 1941 until March 1942, when they were suspended. During this period roadway excavation, drainage structures and a portion of the imported borrow were completed. Sufficient funds for completion were made available during the Summer of 1942 and a contract was awarded to N. M. Ball Sons by Work Projects Administration under supervision of the Division of Highways for the completion of imported borrow, cement treated base and plant-mixed surfacing. Two contracts were awarded later by Work Projects Administration, the first to N. M. Ball Sons for the construction of Jolon Creek Bridge, and the second to Brown, Doke and Baun for seal coat.

EROSION PREVENTION

The highway design, which was essentially the same throughout the project, provided for a subgrade of material having a minimum bearing value of 20 per cent, 24 feet x 0.5 foot cement treated base, 22 feet x 0.25 foot plant-mixed surfacing, eight-foot shoulders of imported borrow with penetration application of liquid asphalt, gutters and berms lined with plant-mixed surfacing and a seal coat for the entire width of the roadbed. An exception to this design was made on a two and four tenths mile section of heavy side hill construction over the summit north of Jolon where the shoulders were surfaced with 3 feet x 0.25 foot plant-mixed surfacing.

An unusual feature of the design provided for the construction of 25 check dams to prevent erosion. The new highway on a two-mile section follows along Hames Creek in a comparatively narrow canyon and it was necessary to confine the creek in a channel parallel to the highway. On account of the friable nature of the soil and the excessive grades of the channel some method was required to prevent the scouring action of the stream. The most practical method of preventing this scour was by the construction of check dams which would maintain a channel grade of 1 per cent. These check dams were constructed of Class "C" concrete and have functioned satisfactorily during the recent storms.

EXCAVATION IN SHALE

Construction problems were not difficult, excavation being in shale and soil cuts that did not require blasting. Local materials were used as aggregates for cement treated base and plant mixed surfacing. Aggregates for concrete structures and seal coat screenings were imported from commercial plants. As aggregates in this area contain reactive shales and chert, low alkali cement was used in cement treated base on all contracts except for about one-half the 3.9 mile unit under contract with Brown, Doko and Baun on which standard cement was used due to curtailment in production of low alkali cement. The most difficult problem presenting itself was in grading operations during the Spring of the year due to saturated soil conditions.

Across marshy areas to the east of Jolon the soil formation consisted of about two to three feet of loosely compacted shale and clay soil overlying an impervious strata. In advance of constructing embankments, longitudinal side ditches under the toe of slope with 10-foot bottom and 2:1 slopes together with connecting cross trenches of the same dimension at intervals of not more than 400 feet, were excavated and the embankment area allowed to drain. The transverse trenches were backfilled with pervious gravelly material. In this manner subsurface drainage above the hardpan is intercepted and carried away by the side and transverse bleeder ditches. Wherever possible cross drainage culverts were placed with flow line at hardpan elevation which in some cases necessitated outlet ditches up to 1,000 feet in length.

CONSTRUCTION METHODS

During the progress of construction five plants operated concurrently in the production of cement treated base and plant mixed surfacing. Construction methods for these items varied but little throughout the project. N. M. Ball Sons used two tractor and dozer spreaders in placing cement treated base full width. Basich Brothers employed one tractor and dozer with 21-foot spreader box, which, with some improvements, should result in the most economical operation. All plant mixed surfacing was laid by means of motor graders.

One feature of the construction methods employed by two of the contractors was the use of blade attachments for the construction of the plant mixed berm and gutter. The device used by Louis Biasotti & Son was capable of three operations: **(1)** Making cut to receive plant mixed surfacing for gutters in cut section. **(2)** Placing and shaping plant mixed surfacing in gutters and on slope of cut. **(3)** Shaping and compacting earth berms and covering with plant mixed surfacing. In one position this attachment performed operations **(1)** and **(2)** and consisted of a curved tool about three feet long of the shape of the gutter with an attached plate adjustable to the slope of the cut. After making the gutter cut, plant-mixed surfacing was placed in the recess and pressed into shape by the tool and the gutter portion rolled by the wheel of the motor grader. The top of the

(Continued on page [illegible])

Picture of dozer spreader with spreader-box blade attachment constructing plant-mixed berm and gutter

Earth-Loading Factors Affecting Field Installations of Culverts

By G. A. TILTON, Jr., Assistant Construction Engineer
R. L. THOMAS, Assistant Engineer, Surveys and Plans

FOREWORD

This is the seventh of a series of technical abstracts from a joint departmental review of culvert practice of the California Division of Highways, by a committee composed of R. Robinson Rowe, Assistant Engineer, Bridge Department, and Clarence F. Woodin, Assistant Maintenance Engineer, and the writers.

The series continues with a presentation of the factors affecting field installation and the structural stability of culverts without benefit of mathematical analysis. This presentation is offered with the hope that the field engineer will be aided in arriving at quick and sound decisions when unforeseen field conditions are revealed during excavation.

FOR practical reasons, culvert designs are based on hypothetical foundation and loading conditions. As excavations for culvert foundations are opened up, conditions are often encountered that are different than assumed by the designer. Likewise, as roadway excavation develops, the character of material proposed for backfill or embankment over the culvert may be of entirely different character than was anticipated.

Unlike the designer, who has plenty of time to study and analyze the factors of design, the field engineer is required to make quick decisions and exercise independent judgment to avoid unnecessary delay of the work when changed conditions appear.

Committee's Observations

It is the committee's observation that there is need for dissemination of the basic principles of earth pressures transmitted to culverts and the effect of various earth loadings on either flexible and rigid structures upon yielding or unyielding foundations. Presentation in a simple manner without detail involvement of theories and formulae should prove helpful to the field engineer in installation problems. It has also been the committee's view that too great a burden of responsibility for adequate design has been thrown upon the field engineer, particularly location detail and hydraulics.

Basic Principles of Earth Pressures Transmitted to Culverts (2) (3)*

The simple laws of mechanics and certain experiments on culvert pipes indicate that the vertical earth pressure on culverts varies according to the relative deflections of the top of the culvert and the adjacent soil each side—ratio of "e" to "E" (Fig. 44a-b-c).

Fig. 44a illustrates an installation of a rigid culvert on an unyielding foundation. In this case (assuming a fairly high fill) the earth alongside the culvert moves downward relative to the material in the prism over the culvert due to the conduit's rigidity and the unyielding foundation of the culvert. This action causes part of the weight of the outside material to be transferred to the prism over the culvert, and "E" is greater than "e." The pressure on the culvert will exceed the weight of the earth prism over the culvert.

Fig. 44b illustrates a case wherein the culvert settles or deflects downward, an amount just equal to the settlement of the plane of material originally level with the top of the culvert. The load is materially reduced, and "E" may approximate or equal "e." The pressure on the culvert will approximate or just equal the weight of vertical earth prism above the culvert.

Fig. 44c illustrates an installation of a flexible culvert on a yielding cushion or yielding foundation. In this case, again assuming a fairly high fill, the earth prism directly over the structure settles downward relative to the material alongside due to appreciable shortening of the vertical diameter of the flexible culvert and by settlement of the bottom into a

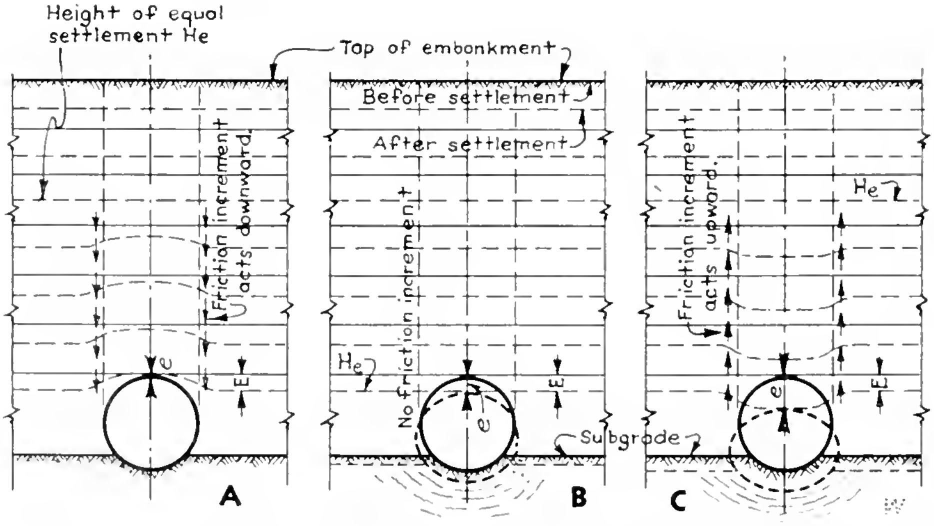


Fig. 44. Three culvert installations, each carrying widely different loads from same height of cover material. Solid horizontal lines represent imaginary planes of embankment before settlement. Dashed lines represent the same planes after settlement has taken place

* Numerals in parentheses refer to bibliography at end of article.

yielding subgrade. "E" is less than "e." The pressure will be less than the weight of the earth prism over the culvert.

Definitions

The qualities "flexible" and "rigid" have been used in a general sense, but Marston (1) has defined them.

Flexible Culvert one whose cross-sectional shape can be distorted sufficiently to change its vertical and horizontal dimensions more than 3 per cent before causing materially injurious cracks.

Rigid Culvert one whose cross-sectional shape can not be distorted sufficiently to change its vertical or horizontal dimensions more than one-tenth per cent without causing materially injurious cracks.

Plane of Equal Settlement (3)

In every embankment sufficiently high, there is a horizontal plane at and above which the compression of the prism over the culvert just equals the compression of the materials alongside (see Fig. 44a-b-c). This condition results when the compression caused by the greater pressure acting through a lesser height within the prism over the culvert equals the compression caused by the lesser pressure acting through a greater height of the material alongside. This plane is known as the "plane of equal settlement" and its height above the top of the culvert is the "height of equal settlement."

In cases V to VIII that follow, the earth loading on a culvert is greatly affected by the "height of equal settlement" which may be above or below the roadway surface (2).

Basic Principles Applied to Practical Installations

Eight standard cases and two special cases commonly encountered in field installations are presented for illustrative purposes:

Case I. Flexible culvert in trench on unyielding subgrade.

Case II. Rigid culvert in trench on unyielding subgrade.

Case III. Flexible culvert in trench on yielding subgrade or cushion.

Case IV. Rigid culvert in trench on yielding subgrade or cushion.

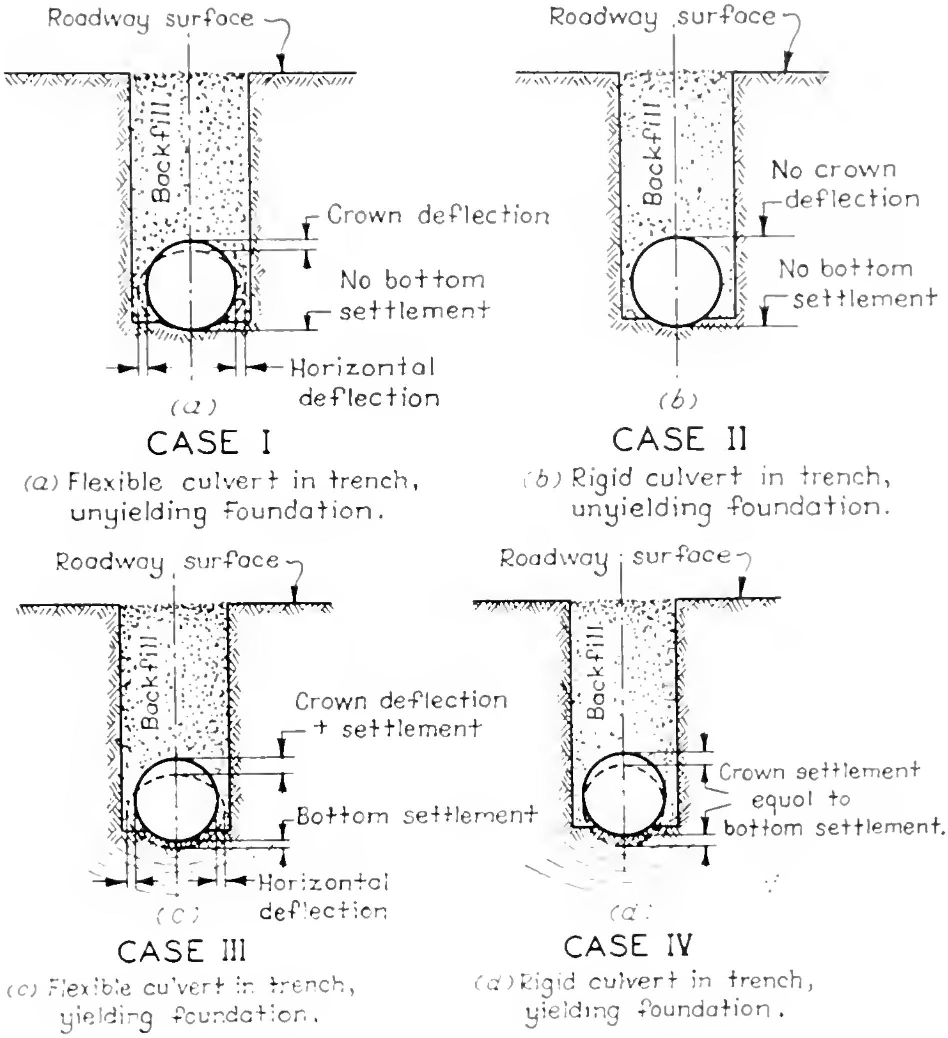


Fig. 45. Four cases of culverts installed in trenches

Case V. Flexible culvert on unyielding embankment subgrade.

Case VI. Rigid culvert on unyielding embankment subgrade.

Case VII. Flexible culvert on yielding embankment subgrade or cushion.

Case VIII. Rigid culvert on yielding embankment subgrade or cushion.

Cases IX and X. Any culvert installed in sidehill location (wrong and right way).

Case I (Fig. 45a). Flexible Culvert Installed in Trench on an Unyielding Foundation

The backfill prism over the top of the culvert in trench tends to move downward relative to the earth alongside, and through frictional resistance and cohesion transfers part of its weight to the soil adjacent to the pipe. In this case the frictional resistance increment acts upward relieving part of the weight of the vertical earth prism over the culvert.

The phenomena have been commonly referred to as "arching action," particularly where rock backfill is used.

If the culvert is of the flexible type further relief of load occurs due to the ability of a flexible pipe to shorten its vertical diameter and lengthen its horizontal diameter.

Case II (Fig. 45b). Rigid Culvert Installed in Trench on an Unyielding Foundation

Action of the backfill prism over the culvert is the same as in Case I, but in the case of a rigid structure, appreciable distortion of the vertical diameter does not occur, resulting in a greater load being carried by the pipe.

Case III (Fig. 45c). Flexible Culvert Installed in Trench on Yielding Foundation or Cushion

The same conditions prevail as in Case I, with a third added. The settlement of the culvert installed on a yielding subgrade further tends to relieve the pressure.

Case IV (Fig. 45d). Rigid Culvert Installed in Trench on Yielding Foundation or Cushion

Settlement of the yielding subgrade or cushion tends to relieve the pressure on the culvert.

As in the case of a flexible culvert installed on excessively yielding subgrades, a highly compacted cushion may be desirable to insure against excessive displacement (see Fig. 18).

Case V (Fig. 46e). Flexible Culvert Installed on Unyielding Embankment Subgrade

In opposition to Case I, there is a tendency for the earth alongside the culvert to move downward relative to the vertical prism over the culvert, causing the frictional increment to act downward and transfer load to the vertical earth prism over the structure. The above is based on the assumption that the materials are homogeneous and that the column of earth adjacent to the culvert moves through a greater height than the column directly over it. As in Case I, some relief of load occurs when the flexible structure deflects.

Case VI (Fig. 46f). Rigid Culvert Installed on Unyielding Embankment Subgrade

The conditions of Case V apply except that the rigid culvert does not deflect sufficiently to appreciably relieve the vertical load. It is the most severe earth-loading condition that will be encountered in the eight standard cases cited. Consideration should be given to some method of relieving the load such as by placing a yielding cushion under the culvert or increasing its structural strength or both.

Case VII (Fig. 46g). Flexible Culvert Installed on Yielding Embankment Subgrade

The same conditions apply as in Case V except that further relief of load may result by yielding of the supporting foundation.

Load is greater than Case III, other things being equal.

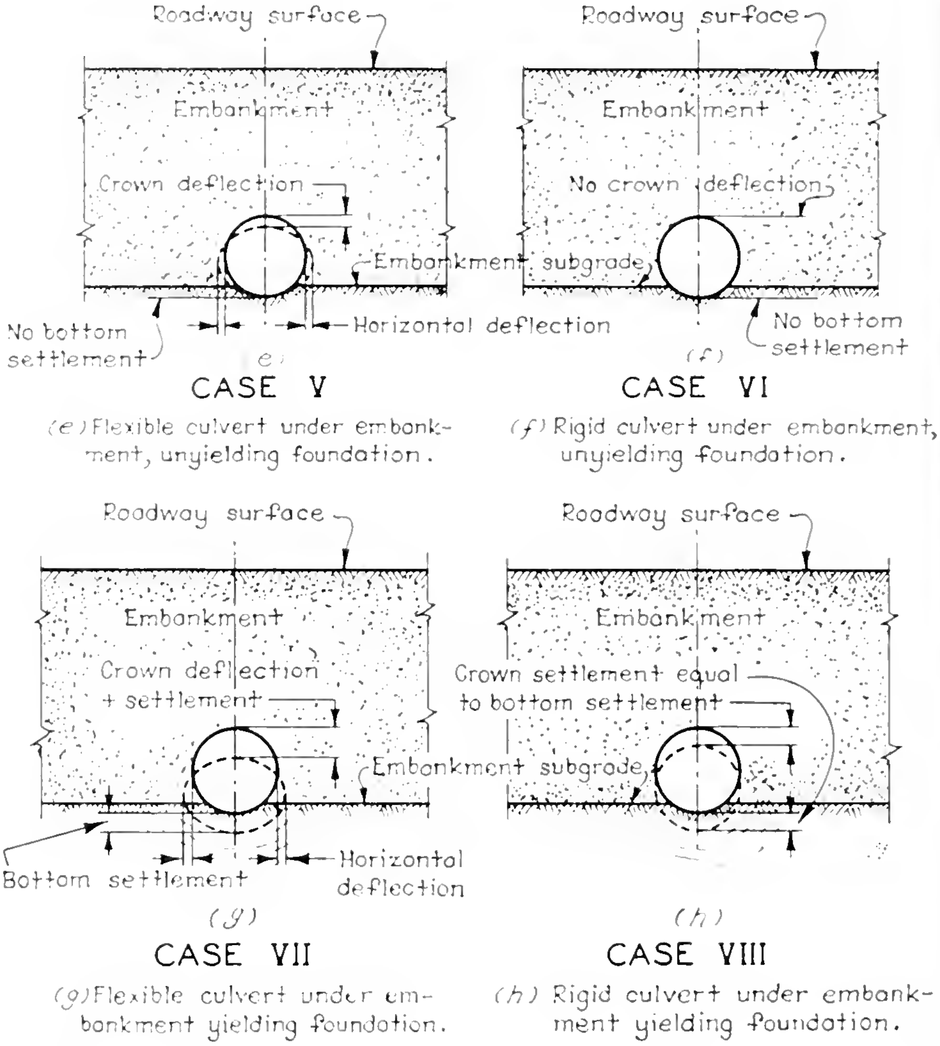


Fig. 46 (e, f, g, h). Four cases of culverts installed on original embankment subgrade

Case VIII (Fig. 46h). Rigid Culvert Installed on Yielding Embankment Subgrade

Case VI applies except that relief of the vertical load results from yielding of the foundation support.

Cradles may be desirable in extreme cases. Tests indicate (4) that supporting cradles under concrete pipe will develop a supporting strength from 1½ to 2 times that which the pipe develops, when not cradled, but this increase in supporting value may be entirely neutralized if the cradles act to reduce the amount of bottom settlement that would normally occur.

Load is greater than Case IV.

Case IX (Fig. 47i). Wrong Method.
Case X (Fig. 47j). Right Method.

Any type of culvert installed in sidehill location.

California experience with culverts placed in the topsoil stratum of sidehill* location has proven to be highly disastrous **(Fig. 47i)**. Culverts so installed are subject to a shearing action that takes place in the topsoil stratum between the settling embankment and the firm material back of the overburden.

Culverts have been completely collapsed in many sidehill location cases such as to be rendered useless. **Fig. 47j** indicates the recommended installation.

Field Installation Considerations

Flexible pipe culverts and rigid pipe culverts are designed structurally to resist average earth pressures expected from certain maximum heights of fills. As every field engineer knows, varied conditions are encountered continuously, including rock foundations, marshy ground, unsatisfactory backfill material, caving

* See November, 1942, issue of California Highways and Public Works.

trenches and many conditions too numerous to list herein.

It is the function of the field engineer to interpret the effect of these various conditions and decide whether the proposed culvert will be subjected to greater or less pressures than average condition designed for and make such changes in the installation as may be necessary to insure structural stability of the culvert.

Unyielding Foundations

Unyielding foundations vary from solid rock to dry hardpan.

A cushion placed under a culvert on unyielding foundation serves the dual purpose of insuring uniform distribution of pressure on the bottom and permitting settlement which relieves the load as described heretofore in Cases I, II, V, and VI.

California 1940 Standard Specifications satisfactorily provide for a cushion as follows (Sec. 56e):

"Where solid rock is encountered, it shall be removed below grade and the trench backfilled with suitable material in such a manner as to provide a compacted earth cushion with a thickness under the pipe of not less than one-half inch (½") per foot of height of fill over the top of the pipe, with a minimum allowable thickness of eight inches (8")."

Compaction should be uniform, ranging from a fairly high degree of compaction under low fills (to limit undesirable settlement in the roadway surface) to a low degree of compaction under high fill (to permit settlement).

Bedding and Backfill Practice

It is the view of the committee that adequate bedding for pipe culverts can not be uniformly obtained by specifying that the trench bottom be shaped to fit the bottom of pipe culverts.

The specification is difficult to enforce for various practical reasons as years of experience on California highways has shown. The bottom rounding specification was removed from standard specifications in 1940 and provision made for compaction of backfill from the bottom of the trench in thin layers, with the option of ponding or jetting granular material in lieu of thin highly compacted layers (see Figs. 49 and 50).

The same difficulty in obtaining proper backfill to culverts has been experienced as in the case of rounding the culvert trench to fit the bottom of pipes. Backfills compacted to a 90 per cent relative compaction are

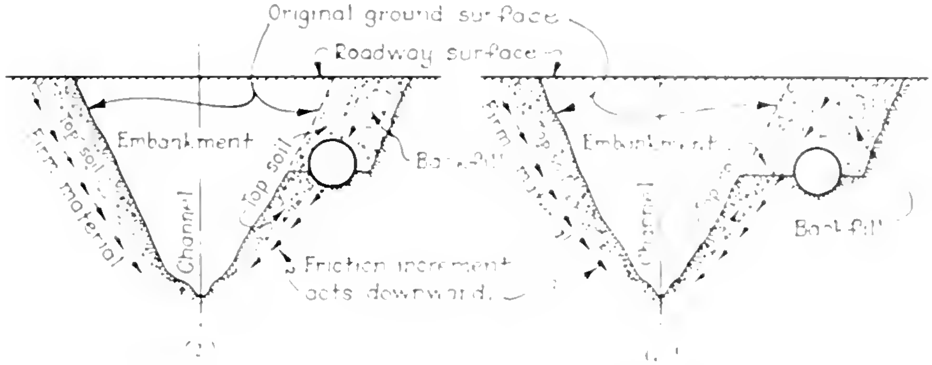


Fig. 47 (i, j). Right and wrong way of installing culverts in sidehill location

Above—Fig. 49. Rock cushion and bedding in lieu of high compaction backfill

Left—Fig. 48. Rock cushion on yielding subgrade for reinforced concrete arch culvert

Below — Fig. 50. Crusher run backfill placed and jetted by contractor in lieu of compaction backfill

exceedingly difficult to obtain where hand tamping is used unless layers of backfill are tamped in 2 or 3 inch layers with optimum moisture content and the tamping head is sufficiently small. Hand-tamping processes are a tedium to the workmen and the contractor alike, requiring most rigorous inspection to insure specification compaction. The same applies to mechanical tampers; unless the tamping head is sufficiently small and the workman applies his weight to the tampers to keep them from bouncing too much, which the average workman is not prone to do, poor compaction results.

Yielding Foundations

Yielding foundations vary from marshy ground containing a high percentage of moisture to low-density spongy topsoil.

In order to insure uniform distribution of pressure on the bottom and sides of a culvert on yielding foundation a layer of gravel or other material of high bearing value should be placed under and on the sides of the structure.

California 1940 Standard Specifications provide for yielding foundation conditions as follows (Sec. 57e):

"Where a firm foundation is not encountered due to soft, spongy, or other unsuitable material, all of such unsuitable material under the pipe and for a width of not less than one (1) diameter on each side of the pipe shall be removed and the space filled with gravel or other suitable material."

Thickness of gravel support is dependent upon the width of structure and nature of supporting subgrade.

Bedding and Backfill

Rounding of culvert trenches to fit the bottoms of pipe culverts has been abandoned in California practice, for reasons previously stated. Replacing the old rounding-of-the-bottom specification, is a provision for placing backfill under and around pipe culverts in thinly compacted layers containing optimum moisture with an in-lieu specification permitting use of ponded or jetted granular materials.

Section 121 of the 1940 Standard Specifications provides as follows:

BACKFILL SPECIFICATION: "Backfill shall be placed in horizontal layers not exceeding four inches (4") in depth before compaction. Each layer shall be moistened and thoroughly tamped, puddled, rolled, or otherwise compacted until the relative compaction is not less than ninety per cent (90%), as determined by the compaction test specified in Section 6, Article (d) of these specifications."

Fig. 51a. Flexible culvert on embankment subgrade covered with earth. Not recommended

Fig. 51b. Rigid culvert on embankment subgrade covered with earth. Not recommended

IN-LIEU SPECIFICATION: "Should the contractor elect to furnish sandy or granular material for backfill, the layer construction may be eliminated and compaction obtained by ponding or jetting. Ponding or jetting will not be permitted where the backfill material is not of a sandy nature nor where the foundation material is such that it will soften when saturated * * *."

Culverts Installed in Trenches

Test results (5) indicate that, as the width of trench increases, other conditions remaining constant, the load upon the culvert increases, until projection condition is reached (culvert projecting above the subgrade under embankment).

Although there is no definite specification limiting the width of trenches, excessive width is discouraged by the specifications by disallowing payment for structure excavation and backfill outside vertical surfaces one foot (1′) each side of the external dimensions of pipes or one foot (1′) outside the neat lines of concrete structure footings.

Culverts Installed on Subgrade Under Embankment (Projection Condition)

As stated in Cases V, VI, VII, and VIII, culverts installed on embank-

Fig. 52. Left—Masonry arch culvert under construction. Right—Same culvert unequally loaded by end-dumped material on one side (material to be rehandled to a lower level for compaction).

ment subgrades generally sustain more earth load than when installed in trenches, as outlined in Cases I, II, III, and IV.

To reduce the load transmitted to culverts under new embankments, specifications provide for construction of the fill to a point above the top of the culvert and then excavating a trench.

1940 Standard Specifications accomplish this as follows (Sec. 57e):

"In the case of pipes twenty-four inches (24") or less in diameter, the roadway embankment shall be constructed to an elevation of six inches (6") above the grade proposed for the top of the pipe, after which the trench shall be excavated and the pipe installed.

"In the case of pipes more than twenty-four inches (24") in diameter, up to and including pipes ninety inches (90") in diameter, the roadway embankment shall be constructed to an elevation of thirty inches (30") above the grade proposed for the bottom of the pipe, after which the trench shall be excavated and the pipe installed.

"In the case of pipes more than ninety inches (90") in diameter, the roadway embankment shall be constructed to the elevation of the third point of the diameter of the pipe (measured from the grade line proposed for the bottom of the pipe) after which the trench shall be excavated and the pipe installed."

A frequent practice adopted by contractors in order to comply with the above specification consists in construction of a mound and then excavating a trench in the mound for installing the culvert (see Fig. 51a-b).

This practice should be discouraged since it tends to defeat the purpose of the specification. The committee recommends that specifications provide for construction of compacted embankment as provided for in the above specification at least five diameter each side of the proposed installation before trench excavation is made.

Structures projecting above the surface of the embankment subgrade should be backfilled evenly on both sides (Fig. 52 depicts an improper method).

Recommendations

It is the opinion of the committee that the present height-of-fill limitations for the various types of culverts are not sufficiently flexible to be economically adapted to the various field conditions encountered, and that there is a need of a study for the purpose of establishing limiting heights-of-fill for various loading conditions for flexible and rigid structures that take into consideration the effect of highly consolidated modern highway embankments and high compaction backfill.

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(4) Bulletin 80, Iowa State College, "Concrete cradles for large pipe conduits," by W. J. Schlick and James W. Johnson.

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List of Articles Already Published in California Highways and Public Works

August, 1942—Preliminary outline of articles.

September, 1942—Comparative Hydrology Pertinent to California Culvert Practice.

October, 1942—Debris Control at Culvert Entrances on California State Highway System.

November, 1942—Highway Culvert Location and Slope from a Review of California Practice.

December, 1942—Culvert Entrances and Headwalls on California Highway System.

January, 1943—Culvert Outlets and Endwalls on California Highway System.

February, 1943—Utilization of Siphon Principles in California Culvert Practice.

Traffic Actuated Signal System in San Diego Solves Congestion Hazards

By R. B. LUCKENBACH, District Traffic Engineer

A RECENTLY completed contract between Market and Couts Streets on the Pacific Highway in the City of San Diego, concludes a series of projects under direction of the State Division of Highways, which render a greatly improved traffic service.

This road is a portion of the State Highway system—U. S. 101—and is the principal entrance to the city. In addition to heavy trucking and through travel, it also carries a very heavy volume of local traffic.

Starting in the fall of 1940, the expansion of war industries and military activity, resulted in serious congestion by increasing the volume and introducing heavy pedestrian movements, with constant turning, stopping and intersection conflicts resulting from proximity of large parking areas, in addition to curb parking.

CONGESTION FROM DELAYS

The four-lane highway proved inadequate under the conditions and loads, and delays of 10 minutes to the mile were not uncommon, with resulting accumulated masses of vehicles extending the congestion to all adjacent areas when they were released.

A series of improvements were planned, with uniform traffic movement as a goal, combined with a minimum of delay and increased safety for pedestrians and cross traffic.

The highway was widened to six lanes, with a parking lane on each side and a six-foot-wide curbed center division, with openings generally restricted to the major city street crossings. Pedestrian overpasses were constructed at three locations of heaviest concentration, and vehicular separations built at three locations where the most serious vehicular conflicts occurred.

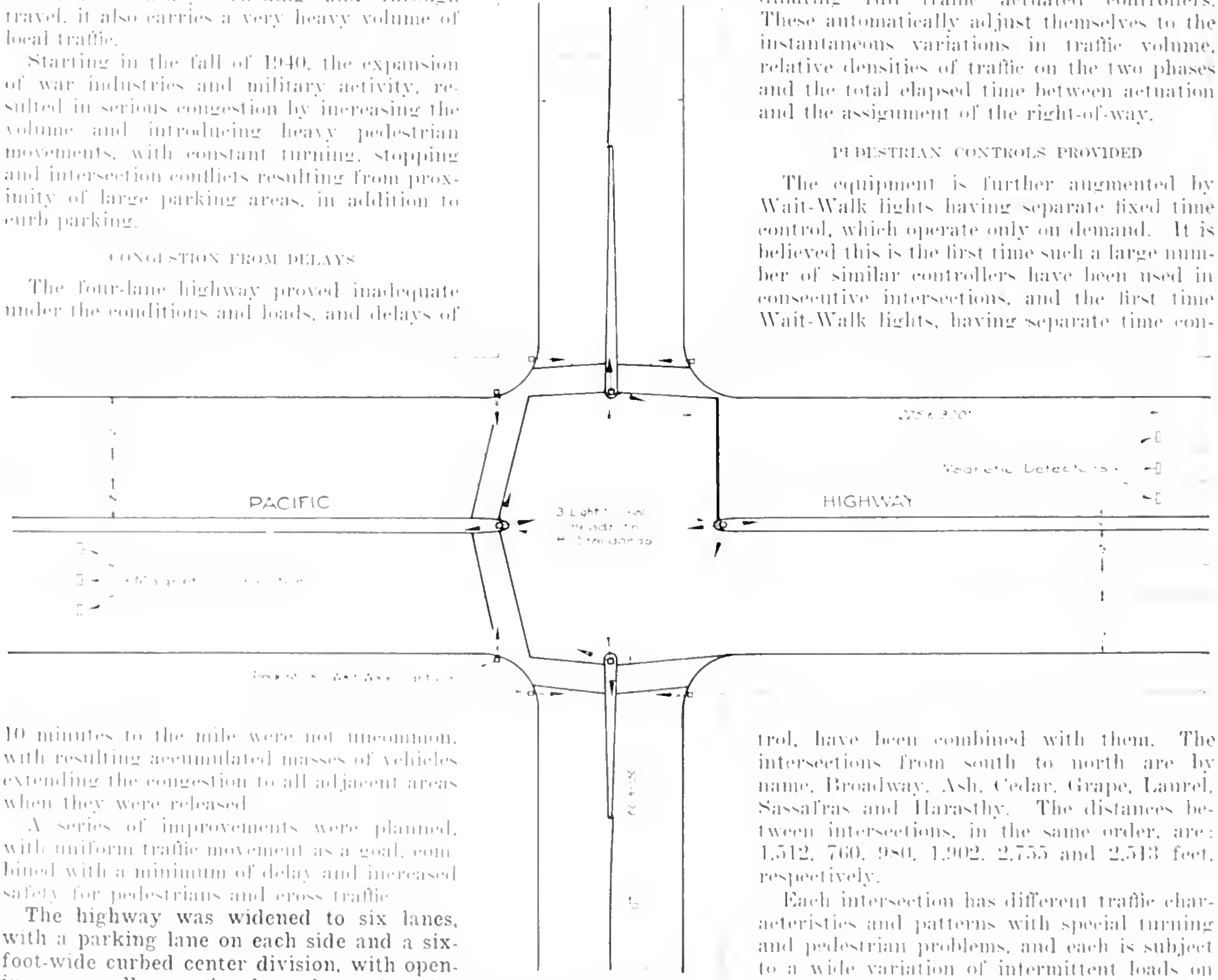
The recently completed contract included the most modern type of traffic control equipment at seven consecutive intersections. The system is fully traffic actuated without interconnection using the latest type of self-coordinating full traffic actuated controllers. These automatically adjust themselves to the instantaneous variations in traffic volume, relative densities of traffic on the two phases and the total elapsed time between actuation and the assignment of the right-of-way.

PEDESTRIAN CONTROLS PROVIDED

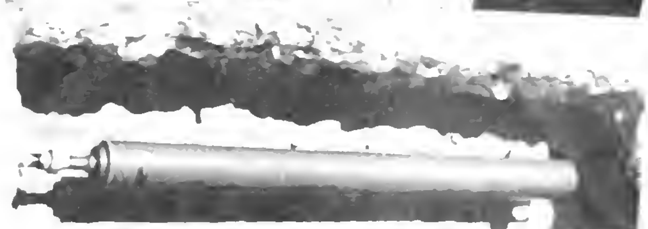
The equipment is further augmented by Wait-Walk lights having separate fixed time control, which operate only on demand. It is believed this is the first time such a large number of similar controllers have been used in consecutive intersections, and the first time Wait-Walk lights, having separate time control, have been combined with them. The intersections from south to north are by name, Broadway, Ash, Cedar, Grape, Laurel, Sassafras and Harasthy. The distances between intersections, in the same order, are: 1,512, 760, 980, 1,902, 2,755 and 2,513 feet, respectively.

Each intersection has different traffic characteristics and patterns with special turning and pedestrian problems, and each is subject to a wide variation of intermittent loads on the approaches, with a consistent volume of 20,000 to 30,000 vehicles per day on the main highway. The Harasthy Street intersection

(Continued on page 14)



Plan of automatic signal system in San Diego actuated by traffic and pedestrians



…es at automatic traffic signals in San Diego. Top left—Electric brain that receives messages from magnetic traffic detectors and …ates signals. Top right—Pedestrians on safety island awaiting effect of push button signal. Center—Market and Pacific inter…on. Bottom left—Pedestrian "Wait-Walk" signal. Bottom right—Left turn signal and magnetic detector buried in pavement has three railroad track crossings with preempting track circuits, all of which are used extensively.

COLLISIONS WERE PREVALENT

Prior to reconstruction, there were fixed time controllers at Broadway, Cedar and Sassafras Streets, the latter two being operated only on demand, by a pedestrian push button, or a contactor in the street. Overtaking collisions were prevalent at these intersections, and one or more property damage accidents occurred nearly every day.

Likewise, vehicles frequently ran the red lights, seriously endangering the pedestrians and requiring constant police patrol. Police direction was required during peak periods at several locations. Crossing was very hazardous, both for pedestrians and vehicles, particularly for single pedestrians. Speeds averaged 25 to 35 miles per hour.

PEDESTRIAN ISLANDS BUILT

In addition to the six-foot, curbed center island for the entire length of the project, small tapered islands were included at each approach to the signalized intersections. Regular three-light traffic signals were placed on eight-foot standards, with a raised base on each center island for vehicular indications.

Two-light "Wait-Walk" signals on six-foot standards were used for pedestrian indications. Pedestrian push buttons were placed on each "Wait-Walk" standard, and on the center standards in the wide highway.

HIGH PEAK TRAFFIC COUNTS

Traffic counts taken during two days in February, 1943, show 15 minute volumes entering the Laurel Street intersection as follows:

P. M.	Thursday	Friday
3:00-3:15	469	484
3:15-3:30	591	385
3:30-3:45	657	663
3:45-4:00	852	570
4:00-4:15	492	664
4:15-4:30	635	770
4:30-4:45	548	485
4:45-5:00	599	556
Peak hour	2,635	Peak hour 2,767

INTERVALS TIMED BY TRAFFIC

Observed operation of the signals show a wide variation in timing as the traffic pattern changes.

A typical timing of consecutive green indication during the peak volumes, are as follows:

A Phase, Secs.	B Phase, Secs.	A Phase, Secs.	B Phase, Secs.	A Phase, Secs.	B Phase, Secs.
31	18	32	18	26	19
30	24	57	22	25	20
34	24	47	19	17	16
35	23	40	17	30	22
33	13	32	15	27	14
63	22	39	19	35	19
46	20	25	12	38	23
26	17	35	14	36	21
32	27	37	25	37	20
37	23	40	15	34	25
36	20	30	14	34	26
40	22	59	11	32	29
40	24	30	15	50	23
51	23	36	20	31	24
33	23	31	19	33	24
32	20	55	16	24	18
47	22	30	18		

MAGNETIC DETECTORS USED

Vehicle detectors are a magnetic type that operate by the passage of a car, inducing a small current in a coil placed under the pavement, which, in turn, is amplified by an electronic relay unit to operate the controller relays. A four-foot detector was used in each lane of travel on the Pacific highway, or a total of six at each intersection.

One or two six-foot detectors were used on the side street, depending on the volume of right turns. Two amplifying relays were used for the six detectors on the main highway, the two outside ones on one approach, being connected in series with the center one on the opposite approach.

PUSH-BUTTON SIGNALS

Separate pedestrian interval timers were used on each phase. These timers consist of a small synchronous motor and necessary relays to operate the "Wait-Walk" light. The pedestrian indication rests in the "Wait" position until a call is received from a pedestrian push button, and does not change from vehicle actuations. The pedestrian call also registers a single vehicle actuation, so that at the next change in phase, the "Walk" light comes on with the vehicle green. "Walk" periods of 11 to 15 seconds were used with a protection period of 4 to 7 seconds, plus the amber time, which varies from 2½ to 3½ seconds.

The synchronous motors have various cycles and will repeat after a full cycle, providing no call has been registered in the opposite phase. The minimum green without pedestrian actuation is 6 to 10 seconds.

Two of the intersections have only one side approach. Both have very heavy pedestrian movements, with vehicular traffic on the side street being principally right turns from east to north, and corresponding left turns from north to east. Pedestrian indications were used only on the southerly cross walks of these intersections, and southbound left turns are permitted against the main highway red indications by use of a green arrow signal mounted five feet high on the center posts.

A pressure sensitive vehicle detector was placed in such a position that the left turn vehicles would cross it and hold the signal to permit several such turns. Due to the elimination of many center curb openings, "U" turns are permitted at these intersections. The left turn movement is made by crossing a normal westbound left turn, but no trouble has been observed from this minor conflict.

During peak periods, when the interval is held by the pedestrian movement, this device operates very effectively and safely, as the left turns can be made without conflict with either the major flow of vehicles or pedestrians.

SATISFACTORY RESULTS ACHIEVED

The installation may be said to be thoroughly satisfactory in that it accomplished the desired results. Vehicular movement is remarkably uniform and smooth. Delays are short and infrequent, and the entire system can often be traversed without stopping.

Pedestrian observance is rather poor on the side street "Wait" lights, but quite good across the main highway. The pedestrians are observed to walk much faster, group better, and stragglers are greatly reduced, so that traffic is seldom held up at the end of the red period, due to pedestrian interference. The few stragglers or persons desiring to walk abnormally slow, can take refuge on the center island, with safety, where they will not hold up vehicular movement.

The signals are equipped with blackout shields, and operate 24 hours a day.

Rufus: "How are you getting along with your arithmetic?"

Susan: "Well, I've learned to add up the oughts, but the figures still bother me."

Effects of New Asphalt Rationing and Restrictions on Highway Work

By H. B. LAFORGE, Assistant Office Engineer
J. G. MEYER, Assistant Office Engineer

TWO recommendations (or orders) have been issued by the Office of Petroleum Administrator For War which have considerable effect upon agencies charged with the responsibilities of public road construction and maintenance.

Recommendation No. 45 (Amended October 5, 1942, to include California and 9 other Western States) prohibits the use of road oil for road work. It restricts the use of other asphalt products to road and street projects considered necessary to the successful prosecution of the war. The latter phrase is interpreted to include essential civilian traffic.

Recommendation No. 61 was dated November 17, 1942, and restricted the manufacture of asphaltic products to certain listed grades. The principal object of this restriction apparently was to release storage facilities for other purposes.

REQUIRES A CERTIFICATE

Operation of Recommendation No. 45 requires an asphalt certificate authorizing each proposed use. The recommendation effectively places in the hands of the Federal Public Roads Administration the responsibility of administration and of applying the certification to approved applications.

The various State Highway Departments are required by the recommendation to assist in administration by reviewing all applications which involve public roads and forwarding them to the Public Roads Administration with recommendations relative to approval or a statement of pertinent facts concerning the particular application.

In California this review is handled by the several State Highway District Engineers who, being familiar with their territories, are best able to accomplish this and with a minimum of time.

The application form B-1 is designed to assist the applicant in making a proper showing for the work he considers essential and to support the quantities requested. These applications should be completed in full and forwarded to the District Office of the Division of Highways covering the geographic area in which the proposed work lies.

APPLICATION COVERAGE

Application paper work has been reduced by permitting combinations of specific requirements. The ordinary maintenance requirements of cities and counties may be handled in one to three applications, depending upon the nature of the work and its magnitude.

One application may be submitted covering an entire city's or county's general maintenance or day-to-day patching requirements for a calendar year. This should include a statement of the miles or area in square yards of bituminous roads to be maintained and a tabulation of the quantities of asphaltic material used for similar work in the previous year.

The application need not be accompanied by detailed maps and can include material to be used in remixing short sections of oil-treated roads throughout the system without a definite commitment from the applicant as to the specific portion to be repaired by this method. The estimated use by quarterly periods should be indicated.

A second application may be submitted covering the annual requirements for maintenance work covering large scale seal coat work and retreading or blanketing. This application should also be on an entire city or county basis, and should be accompanied by maps which indicate by number the locations of the several projects. These numbers should tie in with an attached tabulation showing for each project the termini, the gross and net miles, the type of work, the width, the kind of asphaltic product to be used and the thickness or rate of application.

The amount of asphaltic material used in the preceding year for similar work should also be shown.

It may be desirable to submit a third application for the heavier blanketing work rather than include such among the lighter blankets and seals in the second application.

YARDSTICK FOR PROJECTS

Projects which will result in material improvements and cannot be classed as replacement, restoration or reconditioning are considered construction projects and require separate applications for each unrelated project.

The yardstick by which proposed work is reviewed is here given and is arranged commencing with the type of work most likely to receive favorable action and ending with the type of work which must receive much careful study both by the applicant and the final reviewer.

(1) Maintenance.

(a) Patching work, where feasible, should be undertaken in preference to surface treatment.

(b) Surface treatment should be substituted for reconstruction.

(c) Intensive or unusually heavy maintenance should be undertaken in preference to new construction.

(2) Construction.

Only those construction projects which would be eligible for a preference rating order such as P-19e should be considered for construction. On these proposed construction projects as distinguished from maintenance projects consideration should be given

(Continued on page 16)

Elimination of Rindler Creek Bridge Bottleneck on American Canyon Road

By C. J. TEMBY, District Office Engineer, District X

IN the latter part of 1936, the American Canyon Cut-Off, in Solano County, extending from Carquinez Bridge to west of Cordelia on U. S. Route 40, State Highway Route 7, was completed and opened to traffic as a two-lane paved highway, excepting about 1.3 miles of three-lane pavement between the Vallejo junction and the Benicia Road.

At that time the volume of traffic was about 1,500 vehicles per day. Since then the traffic has shown a steady increase up to 1941, when the Sunday traffic census showed for a 16-hour period that the volume of traffic was approximately 9,900 vehicles. In 1942, the Sunday traffic fell off to about 8,700 vehicles, or a decrease of about 12 per cent.

With the constant increase of traffic, the two-lane highway through the American Canyon became crowded. Because of the topography and country involved, long grades were necessary for portions of this road.

HAZARDOUS TRAFFIC PROBLEM

The volume of truck traffic over this route is large and the speed of the heavy vehicles is slowed down very much on the long grades. This created a serious traffic problem and resulted in several accidents. To remedy this condition, it was necessary to provide additional traffic lanes and widen the roadbed.

A construction project in 1941 eliminated about 2.3 miles of the two-lane pavement through the widening to a four-lane pavement. This work was described in an article by Robert E. Pierce, appearing in the California Highways and Public Works in December, 1941, issue.

Because of the limited funds available at that time, widening of the portion across Rindler Creek bridge and the fill approaches to the bridge was omitted. With the completion and opening to traffic of the four-lane units on each side of the bridge, a bottleneck was created by the narrower portion of the road.

Rindler Creek bridge was built in the original construction of the American Canyon project as a temporary timber structure with a 34-foot roadbed and about 55 feet in height, measured above the natural ground level.

SLIDES PROVIDE FILL MATERIAL

After studying several methods of correction which involved, (1) widening the existing bridge, (2) constructing a new bridge, or (3) removing the existing bridge and replacing it with a fill, it was decided to follow the last plan.

Cut slides in the American Canyon about one-half mile in both directions along the highway from Rindler Creek have been moving and causing considerable concern for several years. The unloading of these slides will provide sufficient material for constructing the fill thereby "killing two birds with one stone," viz. eliminate the bottleneck and reduce, if not overcome, the slide difficulties. These slides have required a great amount of maintenance attention and expense since the original grading project of the American Canyon highway.

CULVERT THROUGH FILL

Rindler Creek is a natural drainage for the adjacent area and in removing this bridge, provisions have been made to carry the drainage through the fill in a field-assembled plate culvert 105 inches in diameter, 270 feet long.

The proposed work will consist of removing the existing bridge, installing the field-assembled plate culvert and constructing a graded roadbed 48 feet in width, with a Portland cement concrete base 44 feet wide thickened at edges and intermediate quarter points.

The thickness of the Portland cement concrete base will be 0.50 foot, increasing to 0.75 foot in 2 feet at edges and quarter points. This concrete base will be covered with an asphaltic concrete pavement 44 feet wide by 0.25 feet in thickness.

The approaches to this described improvement will consist of widening the existing 20-foot pavement to 44 feet by constructing two 12-foot Portland cement concrete widening strips 0.50 foot thick at the center, increasing to 0.75 foot thick at the outer 2 feet. These widening strips will be surfaced with asphaltic pavement 0.25 foot thick.

DETAILS OF WORK

Involved in the proposed work is approximately 89,000 cubic yards of excavation for placing in the new fill, 700 tons of asphaltic concrete pavement, 775 cubic yards of Class "B" Portland cement concrete base, 270 l. f. of field-assembled plate culvert, and several other miscellaneous items of work. The total length of the proposed project is 0.5 of a mile long and is under contract by L. Biasotti & Son at an approximate cost of $145,000.

Because of the inclement weather making the ground unworkable, the construction activities have been suspended and will be resumed as soon as weather and ground conditions permit. Mr. A. K. Nulty is resident engineer in charge of construction for the State.

New Asphalt Rationing

(Continued from page 15)

to an increased thickness of untreated base to permit of a minimum of asphaltic material in the surface. However, designs based on normal factors of economy and traffic service are acceptable if asphaltic materials are available, and the transportation problem is not sufficiently acute to control use.

Completion of street work within bona fide housing projects have been

[illegible] many cases [illegible] of [illegible] from the original plans have been made.

It should be noted that the [illegible] of an asphalt [illegible] does not relieve the [illegible] with other Federal Regulations such as Conservation Order [illegible].

It [illegible] that [illegible] by rail and, to a lesser degree, by truck, is [illegible] of asphalt [illegible] road oils.

[illegible] is necessary to [illegible] equipment [illegible] possible extent, and [illegible] essential [illegible] be postponed, should be attempted. In general, an [illegible] in [illegible] years.

The second order referred to, or Recommendation No. [illegible], restricts the [illegible] to the following [illegible] grades:

ASPHALT CEMENTS

PENETRATION RANGES—50-60, 85-100, 120-150, 150-200, 200-300. Federal Specifications—SS-A-706a (November 26, 1940) and SS-R-406a (April 25, 1942). The new 200-300 penetration asphalt is an attempt to provide an equivalent for SC-6.

MEDIUM CURING CUTBACK ASPHALTS:

MC-1, MC-2, MC-3, MC-5. Federal Specifications—SS-A-671a (June 20, 1941) and SS-R-406a (April 25, 1942).

RAPID CURING CUTBACK ASPHALTS:

RC-1 [illegible], RC-2, RC-3, RC-5. Federal Specifications—SS-A-671a (June 20, 1941) and SS-R-406a (April 25, 1942).

Top—Picture of Rindler Creek bridge in American Canyon to be replaced by fill and below, large metal culvert being placed to carry creek waters through fill

New Freeway Structures Show Twisting and Turning Designs

By L. C. HOLLISTER, Bridge Design Engineer

THE Pomeroy and Soto Streets traffic interchange structures now nearing completion in Los Angeles give the highway user a glimpse of many interesting things to come in the shape and form of freeway bridges. These structures for the freeways of tomorrow will take on odd shapes and new appearances as they twist and turn with the interchange lanes which must weave in and out, under and over, in order to provide for an endless flow of uninterrupted traffic.

These structures are a part of the Ramona Freeway which some day will extend from the Aliso Street Bridge in Los Angeles to the east. This freeway is typical of many others needed in California today and on which it is hoped construction can start at the close of the war.

INTERCHANGE TRAFFIC

The Pomeroy and Soto Streets structures provide for the interchange of traffic between Soto Street, an important traffic artery, and the Ramona Freeway. Traffic headed north on Soto Street may turn west toward the city onto Ramona Freeway by using the Pomeroy structure, and city bound Ramona traffic may turn south onto Soto Street by using the Soto Street structure.

Highway structures have been built before to provide for curved alignment but few if any have ever been made to provide for the twisting curvature, with reversing superelevations represented in these latest designs. Construction methods previously used have always been mean to build and abortive in appearance when completed. Realizing that the freeway of the future would have many structures with similar demands, a more satisfactory solution was sought.

Reinforced concrete girders built to conform to the sharp curvature and changing superelevation of the interchange lanes seemed a reasonable solution structurally as well as aesthetically. Each of the structures, which are about 400 feet long, was constructed of four concentric lines of continuous curved girders from one end to the other. The girders were boxed in providing a smooth surface top and bottom giving the structure as a whole the appearance of a continuous ribbon of concrete bent and twisted to the desired shape.

In addition to the horizontal curvature, the bridges conform to a vertical curvature, and a changing superelevation up to 7 per cent. The superstructures, therefore, resemble elevated box culverts which curve vertically to conform to the highway grade, tilt sideways to conform to roadway superelevation, and curve horizontally to conform to the highway alignment.

REVERSE AND COMPOUND CURVES

Each structure has four lines of girders spaced at 10 feet, and although the spans vary from 40 to 70 feet a constant girder depth of four feet is maintained throughout. One structure has girders built on reverse curves of 200-foot (29-degree) and 615-foot radii. The other structure has girders built on compound curves of 200-foot and 1,360-foot radii.

Because the foundation conditions required the footing pressure to be held to two tons, and because the open column bents appeared more flexible than usual, there was at first some concern for the possible effect of the combination of temperature, shrinkage, and torsional moments on a continuous curved girder design. Consideration during preliminary design stage was, therefore, given to simple span, straight girder construction for that portion with the 70-foot span on a 29-degree curve.

DESIGN CONCLUSIONS

The conclusions arrived at by a comparison of the two types were as follows:

(1) The simple span straight girder type was found to cost considerably more.

(2) For the straight girder layout the development of the members for the sharp curves, with abrupt changes in grade, and superelevation would have been difficult and awkward, would have required more head room, and would have been less resistant to external side loads.

(3) While the construction of girders curved in a horizontal plane was somewhat unusual, there appeared to be no forces, moments, or torsions that could not be adequately provided for by reinforcement and proper construction details.

HORIZONTAL CURVE COMPENSATIONS

(4) It was further concluded that the difficulty of forming the girders to a horizontal curve would be more than compensated for by the simplification of other details, such as: Constant distance between girders, constant depth of girders, and constant overhang outside of girders.

(5) The straight girders in contrast with the sharp curvature would result in an unsatisfactory appearance with varying dimensions and awkward cut-up details. The curved girders on the other hand presented a structure with pleasingly continuous lines and surfaces.

Design analysis indicated that although the middle ordinates of the 70-foot curved beams were approximately three feet, the torsional moments could easily be counterbalanced by: (1) Special reinforcement of girder webs, (2) by the use of diaphragms at about 15-foot centers rigidly tying together the four lines of girders, and (3) by the great stiffening effect of the top and bottom slabs of the box girder construction.

The torsional reinforcement was composed of two groups of diagonal stirrups inclosing the four surfaces of each beam. The bars in the vertical surfaces were tipped at an angle

View of wide swinging curve of Soto Street traffic interchange structure nearing completion on Ramona Freeway in Los Angeles

of 45 degrees, pointing upward toward the center of the beam on the concave side, and downward toward the center on the convex side.

At the ends of the girders the torsional moments were received by heavy bent caps which transferred the torque to the columns and eventually to the footings. Torsional reinforcement added but a fraction of 1 per cent of the cost of the structure.

During construction the alignment of the girders was accomplished by lowering plumb bobs through small holes bored in the bottom slab forms to an exact layout of the girders previously made on the ground.

To give the outside girders a smooth curved surface, five-eighths-inch plywood extending the full depth of girders was used. Bolts at 16-inch centers drew the forms into place and held them firmly in line. Forms for the inside girders and fillets that are hidden from view were built on short chords.

SETTING OF SCREEDS

Since no wearing surface was placed on the concrete deck considerable care was used in finishing to a smooth grade. Longitudinal 2-by-4-inch screeds located at each gutter line with laps spliced for continuity were supported by adjustable bolts at six-foot intervals. The bottom edge of the screed was thus constantly maintained at the elevation of the finished concrete deck. Screeds were set to provide for one-half inch of camber in the 40-foot spans and three-fourths inch of camber in the 70-foot spans.

Pomeroy Street overhead, a companion traffic interchange structure to Soto Street, shows a twisting reverse curve alignment

California has constructed other reinforced concrete girders on horizontal curves as listed in the following table:

Date	Name	Radius of curvature, feet	Maximum span length, feet
1938	San Francisco-Pacheco Creek	2,000	44
1938	Pacheco Creek	2,000	67
1939	Funston Avenue	299	78
1940	San Rafael Viaduct	1,050	40
1940	Schooner Gulch	800	120

Asphalt Rationing

(Continued from page 17)

Rapid curing cutback asphalt RC-1 may be manufactured only when this product is to be transported from a refinery to a terminal via barges.

EMULSIFIED ASPHALTS:

TYPES I, II, III, V. Federal Specifications—SS-A-674 (May 7, 1935) and SS-A-674 Amendment—1, (March, 1936).

Unfortunately, the order did not take into consideration the difference in methods, materials, and climatic conditions in the different geographical areas of the United States, having apparently been written with Eastern practices in mind.

The elimination of the lighter SC-oils has worked great hardship on western road agencies who have found it necessary to maintain earth roads by the process of discing, retempering and relaying.

Another very serious effect of this restriction was the elimination of ROMC-3, which along with SC-3, previously eliminated, were the most widely used in the preparation of premix in California.

The most practical, permissible substitute for ROMC-3 for pre-mix is the MC-3. However, MC-3 without modification, is not considered entirely satisfactory for this purpose. In order to partially solve the pre-mix problem, the base asphalt used in the manufacture of the MC-3 must be as soft as possible within the range of residual penetrations permitted by the controlling Federal specifications.

Representatives of several oil companies have indicated that it will not be difficult to produce such a material within the residual penetration ranges of 225 to 300, which it is hoped will provide a softer product nearer to ROMC-3 characteristics.

Recommendation No. 61 also limits the grades of emulsified asphalt which may be manufactured. It is no longer possible to secure the California Division of Highways' Specification asphaltic emulsion penetration type with the SC-6 base, except for stocks which the manufacturer may have had on hand. Assuming that no modification can be made, this leaves available only the 150-200 penetration base type which is not considered satisfactory for all uses requiring penetration type emulsion.

Bids and Awards

ALAMEDA AND CONTRA COSTA COUNTIES—Diesel oil to be applied to roadside vegetation for a length of about 61 roadside miles. District IV. Sheldon Oil Co., Suisun, $2,400. Contract awarded to Close Building Supply, Hayward, $2,261.

LASSEN COUNTY—Across Long Valley Creek about 13 miles north of Doyle, timber bridge to be constructed to replace bridge recently washed out. District II. Frank George, Sacramento, $10,892; A. Soda & Son, Oakland, $12,660. Contract awarded to J. D. Proctor, Inc., Richmond, $9,952.

LOS ANGELES COUNTY—Across Los Angeles River and the tracks of the Southern Pacific R. R. and the Los Angeles Railway at Figueroa Street in the city of Los Angeles, a portion of the superstructure of a bridge to be constructed. District VII, Route 165, Section L. A. Robert R. Hensler, North Hollywood, $17,610; E. G. Perham, Los Angeles, $18,610; The Contracting Engineers Co., Los Angeles, $19,280; Oberg Bros., Inglewood, $20,270; Bonadiman McCain, Inc., Los Angeles, $21,736; Carlo Bongiovanni, Hollywood, $27,634; Fred E. Potts Co., Los Angeles, $29,388. Contract awarded to United Concrete Pipe Corp., Los Angeles, $16,370.

MARIN COUNTY—Near Waldo Point, about 0.4 mile to be graded and surfaced with plant mixed surfacing on imported rock base and a reinforced concrete grade separation structure to be constructed. District IV, Route 1, Section B. A. G. Raisch, San Francisco, $84,917; Heafey Moore Co., Oakland, $86,520; Macco Construction Co., Oakland, $89,183; Guy F. Atkinson Co., San Francisco, $98,272; Parish Bros., Sacramento, $99,280; Louis Biasotti & Son, Stockton, $99,921. Contract awarded to N. M. Ball Sons, Berkeley, $82,912.

MARIN, NAPA AND SONOMA COUNTIES—Diesel oil to be applied to roadside vegetation for a length of about 113.1 miles. District IV. Sheldon Oil Co., Suisun, $4,050; Close Building Supply, Hayward, $4,500. Contract awarded to Pacific Truck Service, Inc., San Jose, $4,035.

SACRAMENTO COUNTY—Between State Highway Route 3 and Camp Kohler, about 0.6 mile to be graded and surfaced with plant mixed surfacing. District III. McGillivray Construction Co., Sacramento, $22,822; J. R. Reeves, Sacramento, $23,541; M. E. Whitney, Bakersfield, $23,576; Hemstreet & Bell, Marysville, $25,494. Contract awarded to A. Teichert & Son, Inc., Sacramento, $21,396.

SAN DIEGO COUNTY—For constructing traffic signals on Route 2 at Juniper Street in San Diego. District XI. C. D. Draucker Co., Los Angeles, $3,000. Contract awarded to Econolite Corporation, Los Angeles, $1,275.

SHASTA COUNTY—Between west entrance Redding Airdrome and Route 20, about 3.9 miles to be graded and surfaced with plant mixed surfacing. District II. A. R. McEwen, Sacramento, $78,659; Hemstreet & Bell, Marysville, $78,881; M. W. Stanfield, Los Angeles, $82,850; Brown, Doko & Baun, Pismo Beach, $87,268; A. Teichert & Son, Inc., Sacramento, $89,914; J. P. Brennan, Redding, $126,976. Contract awarded to M. J. Ruddy & Son, Modesto, $77,972.

SOLANO, CALAVERAS, SAN JOAQUIN, AMADOR, MERCED, MARIPOSA AND STANISLAUS—Oiling roadside vegetation at various locations in District. Awarded to Sheldon Oil Co., Suisun, $4,756.

A man is not paid for having brains, but for using them.

Grapevine Canyon Grade Divided Highway Widened

(Continued from page 2)

spillway at the lower end was constructed. Some 3,800 cubic yards of reinforced concrete were used and provided a channel capable of handling 3,000 second feet of water. It has been said by persons dwelling on the hill above the highway, that since the buttress has been completed, ground vibrations previously felt when heavy trucks pass on the highway, have ceased.

FLUME CARRIES CREEK

In addition to the buttress fill there were 128,000 cubic yards of roadway excavation. A concrete flume constructed over the buttress placed in the canyon along the highway, to carry Grapevine Creek, required 3,800 cubic yards of reinforced concrete. The contract price for all work under the first contract was $385,638. Griffith Company was the contractor.

The same contractor was the successful bidder for the pavement widening on Grapevine Grade. This job provided for the widening to 50 feet of the exising portland cement concrete pavement, plant mix shoulders and the installation of over 20,000 lineal feet of metal plate road divider. The contract price on the second contract was $384,951.

Paving work and the installation of the road divider was carried on under the supervision of Associate Engineer Fred W. Howard, with W. E. Bertken acting as Resident Engineer.

Bradley-King City Highway

(Continued from page 5)

surfacing on the slope was then trimmed to a uniform height with the blade.

EARTH BERMS

By reversing the device on the moldboard it was then in position to be used in shaping berms and consisted of a shape of the berm cross-section, adjustable for height, and tapering from a larger opening at the front to a smaller one at the rear.

The resident engineers for the State were F. R. Pracht and V. E. Pearson.

State of California

EARL WARREN, Governor

Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

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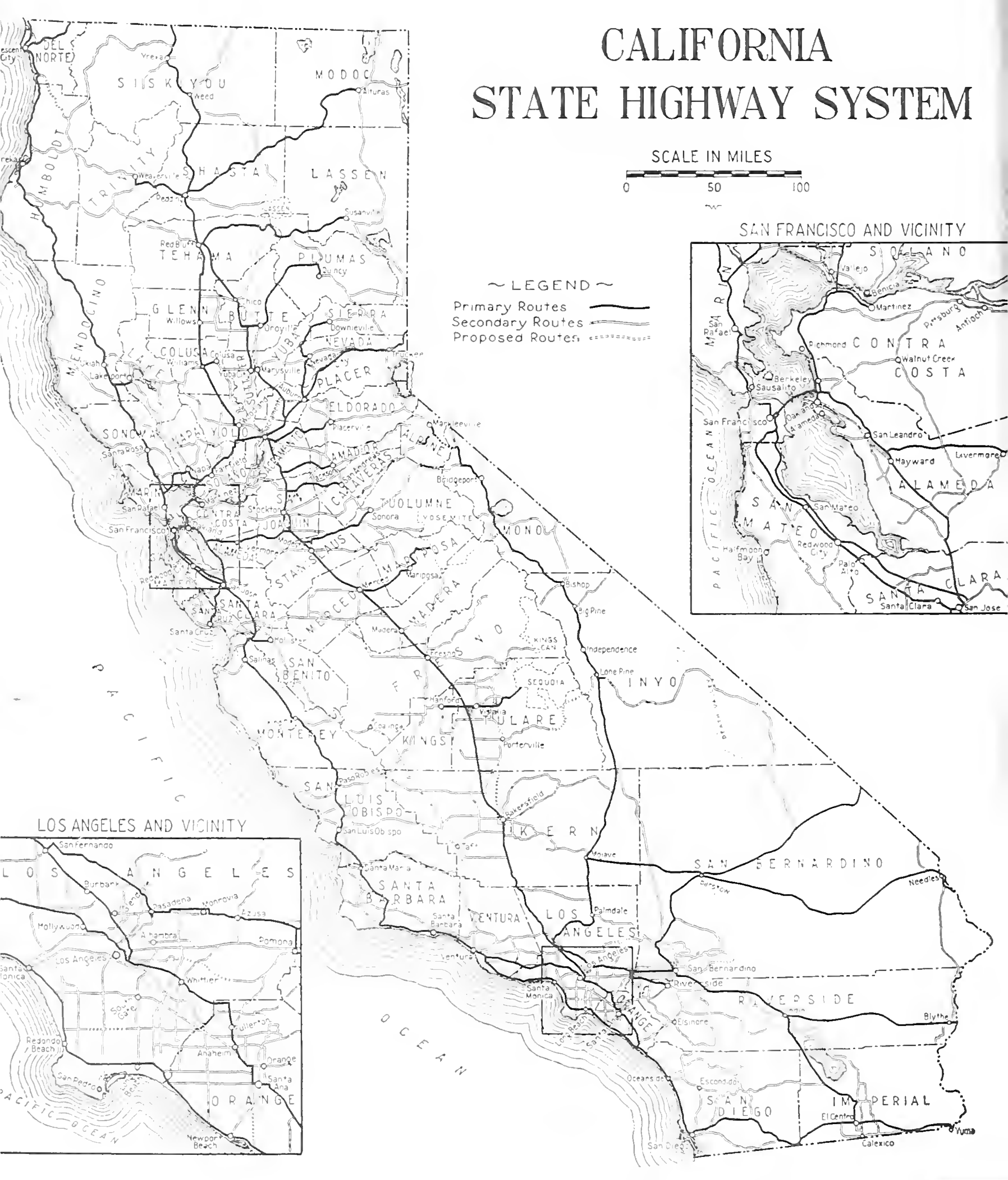

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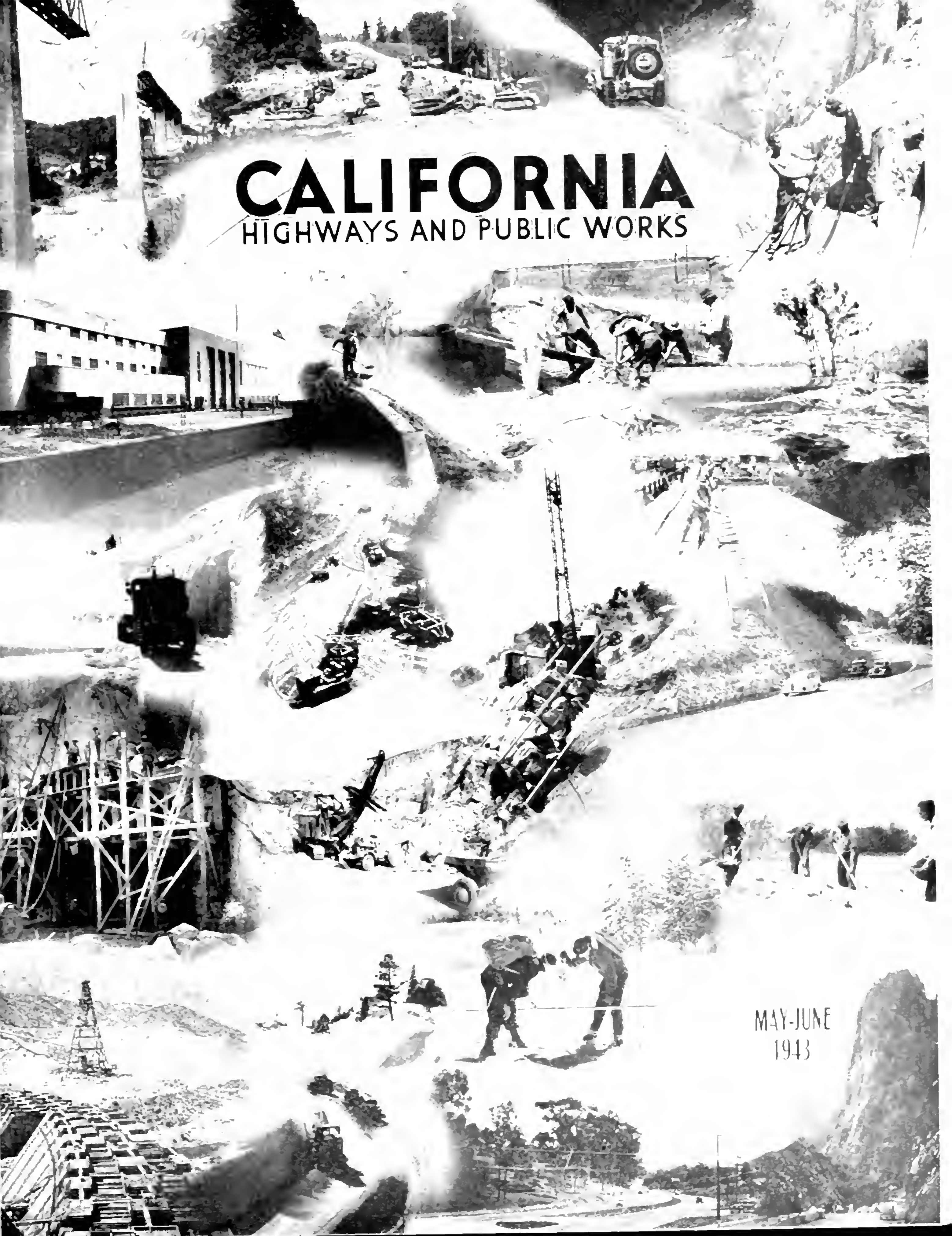

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Gov. Warren's Appeal to President Wins Approval for Central Valley Project Food Crop Features

A CONCERTED drive by public and private agencies, organizations and individuals from California has finally broken the Washington deadlock which for months has threatened to leave the Central Valley Project in a partially completed and unproductive state.

First break in the deadlock came in the form of a letter from President Roosevelt in reply to a personal plea by Governor Earl Warren that the President intercede on behalf of the project. As result of the Governor's plea, President Roosevelt ordered the War Production Board and the Federal Power Commission to reexamine the status of the project and its relation to war production. This led to a revision of the WPB stop work orders permitting installation of control gates on Friant Dam, the completion of the Madera Canal and finishing concrete work on Keswick Dam. That approval of work on other features may be made by the WPB is indicated by the President's letter.

BUDGET BILL INCREASED

Second break for the project came when the budget bill which previously had carried no funds for continuation of work on the project after July 1 was revised to include a $16,500,000 item to finance completion of Shasta Dam. The House Interior Appropriations Subcommittee subsequently reduced this amount to $11,500,000 and the bill as reported by the committee was passed by the House. It is now pending before the Senate and there is a possibility additional funds will be provided for work on the irrigation features approved by the WPB.

Governor Warren has followed the development of the Central Valley Project closely. In his previous post as Attorney General he served four years on the Water Project Authority which represents the State's interest in the project. He thus has an intimate knowledge of the project and the enormous part it can play in increasing the production of critical war crops in California, protecting lands already under cultivation from flood and drought and producing additional hydroelectric power. His letter to President Roosevelt reviewed in detail the present status of the project and what completion of various units of the project would accomplish. He wrote in part:

WARREN LETTER TO ROOSEVELT

"The action of the War Production Board in cancelling priorities on all features of the Central Valley Project except the Shasta Dam and certain attendant power facilities, coupled with the fact that no funds for the project are included in the budget for the 1944 fiscal year, has caused great concern to the people of California.

"I am well aware of your intimate knowledge of and personal interest in this project, exemplified by your allocating $20,000,000 from the Emergency Relief Appropriation on September 10, 1935, making possible commencement of work, and your continued support since that time. Therefore, I am addressing this letter to you to solicit your personal assistance in securing the necessary funds and priorities for the completion of this project, which will yield large values in the prosecution of the war from the standpoint of production of needed food, fiber, and electric power.

"I well recognize that the war has caused many drastic changes in the construction program of the Federal Government, and am heartily in accord with the concept that anything not directly related to winning the war should be postponed for the duration. It is my firm conviction, however, that the production of food, in view of the growing shortage throughout the world, is second only to the production of the materials of war.

"The adaptability of California's soils and the wide range of its climate particularly fit this State for the production of all types of food necessary to the war effort. Many crops are produced on a year-around basis and, compared to other states, the yield per acre is much higher. Lands which the Central Valley Project will serve are heavy producers of beans, potatoes, sugar beets, vegetables, forage crops for beef and dairy production, flax, cotton, and both deciduous and citrus fruits.

VAST CROP POTENTIALITIES

"There are also large acreages in grains and other less essential crops which, if provided with an adequate water supply, could easily be converted to the production of needed war foods. In addition, there is a large acreage, not now in use, which the Department of Agriculture has classified as highly desirable for the production of guayule and which is needed immediately if the Department's present planting program is carried to fruition.

"California agriculture is bending every effort to meet the mounting demands for food within its own borders. A great influx of population to man the war plants has taken place in the last two years. Growing military establishments in every section of the State, with a population that is difficult to estimate, are producing an additional heavy drain on the food resources of California. Valuable shipping space needed for the transportation of war materials is now being used for the importation of food products that could be grown on lands in California. In-

(Continued on page 14)

Control of Roadside Vegetation to Reduce Fire Hazards

By E. S. WHITAKER, Assistant Landscape Engineer

SOME years ago, the agricultural interests of this State figuratively leaned on their collective fences and gazed with ever increasing trepidation across the narrow strip of land separating their properties from the paved roadways that carried the ebb and flow of traffic on the State Highway System. They feared for the safety of their fields of grain, or their pasture lands; their interests also lay directly and indirectly in timber and watershed lands.

Along the highways flowed traffic that yearly became more dense and included local traffic that well knew the dangers of fire; city dwellers and out of State people who did not realize the hazards along the roads' edges throughout a six months' dry season; careless travelers who did not think of the possible havoc to be wrought by an accidental fire.

RESPONSIBILITY OF STATE

Between the fence lines and the traveled way extended a narrow strip of untended land, growing a full complement of grass and weeds that, as part of the right of way, came under the jurisdiction of the State Division of Highways. So far as the owners of the lands beyond the fences were concerned, the hazards caused by the traffic on the highways and existing in the matured growth on the rights of way were the responsibility of the State.

The Division of Highways recognized the benefit of a cooperative program of fire hazard control and in the 1920's began an active program to that end. Portions of the right of way bearing the worst fire hazards and fronting valuable dry crop or timber and watershed lands were treated for such control.

A large amount of the work in the first years consisted of hand removal of brush, hand hoeing around posts and of dry burning. From this start an annual program developed.

It was found that dry burning, alone, was a risky proposition. In order to burn an area clean it was necessary that the growth pass maturity and dry out sufficiently to burn well. By that time, growth in the adjoining fields was also so dry that the danger from spread of fire was constantly at hand.

SPRAYING EQUIPMENT DEVELOPED

There was also the damage resulting from scorching or burning trees on the right of way, and hand labor for their protection became a large item of the yearly roadside charges. Spraying equipment was accordingly devised that could spray a strip well out on the right of way and, wherever possible, directly next to the right of way line.

EXPERIMENTS WITH CHEMICALS

Experiments with chemicals and oils were undertaken to determine what agent would kill the growth quickly and as cheaply as possible. An experiment with large hooded burners and one with live steam was carried out, trying to find a method of destroying green growth so that the hazard of burning during the dry season would be done away with.

DIESEL OIL EFFECTIVE

With the possible exception of a proper chemical used under optimum conditions, no experiment has as yet produced results equal to that obtained through the use of diesel oil. By applying a spray under sufficient pressure to insure penetration of heavy growth, between 30-50 pounds pressure per square inch, and by using from one-twentieth to one-tenth of a gallon application per square yard according to the denseness of the growth, a strip of grass and weeds could be treated and killed while the surrounding growth was green.

After allowing from 10 to 15 days interim for as complete a kill as possible, the sprayed strip could then be burned with little danger of fire spreading outside of the sprayed area. Under favorable moisture conditions, if spraying could be under way while the vegetation growth was still small, a complete kill was secured and burning was not necessary.

With the expansion of the program it was obvious that, while a fire hazard could be said to exist wherever dry grass existed on the right of way, it was necessary to keep the work to a minimum from an economic point of view. A policy was therefore adopted as to selection of areas to be treated. Under this policy work was restricted to areas adjacent to grain, grazing and watershed lands, and in some cases for the protection of timber lands.

SELECTION POLICY ADOPTED

In the selection of areas for protection of grain and grazing lands, the traffic density on the affected portions of each route was a determining factor, for where low count traffic of predominantly local origin constitutes the main portion of the traffic, hazard control is not as necessary as along roads carrying a high volume of mixed type traffic.

Along the coast where climatic conditions are favorable, many miles of roadsides have been fireproofed and improved in appearance by planting ice plant. The two best varieties for this purpose apparently are Mesembryanthemum edule and croceum. Both act not only as soil binders, but crowd out all other grass and weed growth as well. Through their clean green foliage and bright flowers they add greatly to the beauty of the roadsides.

The width of shoulders and of the portions graded for their maintenance also determines whether the roadside should be treated. Wide shoulders, clean of growth—no treatment; narrow shoulders with a fire hazard close to the pavement edge—treatment

At top—Spraying roadside slope with diesel oil preparatory to burning. Simplified adjustable boom equipment is operated by one man from front of tank truck. Bottom—Mowing tall dry growth reducing fire hazard necessary. The area and type of development on private property is still another factor in determining where firebreaks should be established. A few acres of grain or pasture surrounded by orchards or fields of green crops need not be given the same protection as several hundred acres of grain or grazing land that stretches away from the right of way line unbroken by any kind of a firebreak.

DISKING FOR FIREBREAKS

With the addition of county roads to the State Highway System and the general increase of traffic, it became necessary to include more and more roadside mileage in the program. In order to cut the total cost of the work, farm type disks were used to form the firebreak whenever possible. To spray once and then burn a strip nine feet in width costs, by state-wide 1942 average, $53 a roadside mile; to disk a comparable strip costs $15 a mile. While the immediate answer to the difference in costs is apparently "disk everything," such work cannot be done due to the inaccessibility of a large portion of the roadsides to disking equipment on steep cut slopes.

However, the mileage of the disking for the establishment of firebreaks has increased from nothing in 1928 to 537 roadside miles in 1942. In valley sections with wide right of way, disking equipment is put in action as soon as the ground dries out sufficiently to carry the weight of the disk and tractor. On this type of roadside, a heavy disk with retractable rubber tired wheels can be used. With the wheels lowered the disk can be towed behind a truck for rapid transfer from one portion of a roadside to another as conditions require.

RESTRICTIONS ON DISKING

Disking is restricted to the area beyond the gutter or ditch line. No shoulder or slope areas inside this line are disked except under unusual conditions, as the soil loosening action of the disk blades disturbs the desired compaction of the slope or shoulder and its early displacement and dissipation by wind and rain follow. On the other hand, grading equipment can be used to good advantage inside the ditch line. Where space is available, one blade width placed directly next to the portion normally bladed for the maintenance of improved shoulders establishes a satisfactory firebreak.

In 1942, the strip to be sprayed was moved in from the area adjacent the right of way to the first nine feet directly next the improved shoulder. There were a number of advantages gained by making this change. It allowed for more rapid progress of the work, as the innumerable pauses to swing the boom or the spray bar to clear posts and trees were reduced. Equipment could be kept on the traveled way or on the improved shoulder, and it was not necessary to wait for the ground to dry out and become solid enough to hold up equipment in order to place the spray strip near to or directly next the right of way line. Other conditions being favorable spraying could be started at an earlier date.

PRESERVING GREEN ROADSIDES

The sprayed and burned strip in this new location later appeared to be a part of the roadway and did not leave an unsightly and esthetically objectionable scar through the wild flowers and green growth of the roadside. This in itself is no small feature, the Division having received a number of letters, from mildly critical to condemnatory, decrying the destruction of green growth right at the season when the roadsides appeared at their best.

But most of all, the firebreak was placed at the point where the greatest number of fires started. If the fire incidence was the direct result of traffic, then the hazard nearest to the traffic should be controlled. Whereas, with an intervening strip of dry grass between the road edge and the firebreak in which a fire could start and finally gain size enough to jump the break, with a fireproofed area at the point of occurrence the probability of a fire ever getting started is minimized.

It is still necessary, of course, to provide a firebreak by spraying or disking around trees or other plantings before burning can be undertaken. All of this type of work applies only to accidental fires, no work being attempted to anticipate fires of incendiary origin.

Another change put in effect in 1942 was the development of simplified

Disking roadside areas beyond ditch line establishes firebreaks

Burning oil-sprayed roadside growth. Fire is kept in control with water hose connections from truck tanks

spraying equipment. One new development consisted of a folding swivel-toggle boom, which is mounted between the cab and the tank on a tank truck with a pressure pump located either at the side or at the rear of the truck. The boom is operated by one man sitting on the right side of the driver's seat. In this position he can look head and see what to spray and can also coordinate the movements of the driver of the truck.

The unit is particularly adaptable to spraying next to the shoulder edge, and, whereas the rear end heavy boom units needed a crew of three and even four men for operation, this equipment is operated by two men. It was first designed and used by maintenance forces in the San Diego area.

A further development was built in the Equipment Department Shop at Redding using a single pipe toggled in sections for the boom and for supplying the oil to the spray heads as well. This does away with the use of hose. When not in use in moving from point to point the boom is folded away behind the cab, and when the spraying is completed for the season it is easily dismantled and stored. Through the use of improved methods of work and improved types of equipment as described, costs in normal times should be reduced for the spraying operations.

MOWING REDUCES HAZARD

On portions of routes where spraying and burning has previously been done but has been discontinued this year, roadside mowing is now done where necessary, cutting one swath in width. This work, while not fireproofing the mowed strip, does reduce the hazard that exists in standing tall dry growth.

In 1928, some 661 roadside miles were treated for control of fire hazards at a cost of $37,752. By 1942, this program had expanded to nearly 2,600 roadside miles with a total expenditure of $118,179. Due to conditions imposed by the war, the program for 1943 has been reduced to treatment of 1,980 roadside miles of spraying and burning and of disking at a total anticipated expenditure of $86,000.

The amounts shown do not include expenditures by the State Division of Forestry nor the United States Forest Service. The State Forester has cooperated in the program by supervising the maintenance forces in many cases in burning operations. The Forest Service has carried on control work in certain timber areas with their own forces.

While the program for 1943 is being carried out in the normal way with the exception of reduction in volume of work, it is to be expected that changes will be necessary for 1944.

LIMITED BY WAR RESTRICTIONS

Looking ahead, when diesel oil will not be available due to war restrictions, it may be necessary to, in part, return to dry or flash burning operations. It will be necessary also to limit the use of equipment for discing and blading because of tire shortage and inability to replace equipment.

Through the use of high pressure spray rigs designed for use as tree spraying equipment, it is possible to place two spray guns in operation. This equipment will throw a spray of water at the rate of 25 to 30 gallons a minute up to a distance of 100 feet. Strip burning started with pressure torches, when protected by the use of such equipment, can be safely accomplished.

(Continued on page 27)

California Adopts Waterway Ratings for Large Drainage Culverts

By R. ROBINSON ROWE, Assistant Engineer, Bridge Department

FOREWORD

This is the eighth of a series of technical abstracts from a joint departmental review of culvert practice of the California Division of Highways, by a committee composed of G. A. Tilton, Jr., Assistant Construction Engineer; R. L. Thomas, Assistant Engineer, Surveys and Plans; Clarence F. Woodin, Assistant Maintenance Engineer, and the writer.

A "large culvert," for the purpose of this article, may be any section from a 54-inch pipe to a small bridge. Design in this range should include a hydraulic analysis. The empirical rules offered in the text must not be interpreted as safe substitutes for analysis, but, rather, expedients for preliminary or budget estimates. Giving a first approximation, the rules will show need for and simplify the application of hydraulic principles.

THE effect of modern standards of highway alignment and grade on culvert design has been noted, in part, before.[1] In addition to the longer and stronger conduits required by high embankments, the same trend has increased the size of waterway for which a culvert is more economical than a bridge.

For this premise and the discussion to follow, the term "large culvert" includes structures classed as bridges for administration purposes but which are actually culverts on a large scale. Without attempting too fine a division line, any waterway under a highway may be considered a culvert if its entire perimeter is functionally streamlined from end to end.

Objectively, the culvert so confines a stream laterally (to shorten spans) that depth is materially increased. Crown elevation is usually determined as the minimum consistent with the waterway requirement, so that confinement may be vertical as well as lateral. Hence the crown must be streamlined to pass floods without entrapment of drift or generation of major turbulence.

FACTORS OF COST

The longer the waterway the more the saving in structure cost if the stream is narrowly confined. This follows in part from the cost of end transitions (headwalls, endwalls, debris racks and energy dissipators) which are disproportionately expensive for short culverts. Consequently, if a reconstructed highway is multilane or on a high grade over a minor stream, a large culvert may be more economical than a small bridge. For example, a channel 50 feet wide by 4 feet deep formerly spanned by a 40-foot 2-lane bridge might be replaced economically by a triple 8 x 6 box culvert when the highway is widened to 4 lanes.

Such replacements may be made at widely differing sites. In our experience, old bridges have been replaced by pipes as small as 18 inches in diameter and by arch culverts as large as 285 square feet in section. For the small sections, determinant of size is mostly a matter of hydrology, but for those over 15 square feet in section, hydraulic principles become more and more important.

Extrapolation of Formulae

Whether the basic culvert formula leads first to a design discharge or directly to a waterway area, the shape of the waterway under the highway is not taken into consideration. In a particular case, if the required area is 16 square feet, the designer may choose a 54-inch pipe or a 4 x 4 box. The formula would be satisfied if he selected an 8 x 2[2] box or a 2 x 8 box. The latter would be a hydraulic absurdity and also expensive. Up to this size, the cheapest section should be satisfactory hydraulically.

In another case, suppose the required area is 100 square feet. Hydrology will be satisfied by a 135-inch pipe or a 10 x 10 box or a D-19 arch culvert (10.08-foot span by 12.33-foot depth). But if the outfall is free, any of these flowing full will discharge at high, probably damaging, velocity. This outfall velocity would be much less if the designer chose a double 10 x 5 box or a battery of five 60-inch pipes.

The area equivalence of these sections governs only at the culvert entrance. Once flood water has entered the culvert at a certain rate, velocity through the conduit will depend upon roughness of walls, shape of section, gradient of flow line and freedom of outlet. This is apparent at once by examining the Manning formula:

$$V = \frac{1.486\ R^{2/3}\ S^{1/2}}{n}$$

For sections of similar shape, the hydraulic radius, R, increases directly with the size ratio, and velocity as the two-thirds power. Hence doubling the diameter of a pipe adds 59 per cent to the velocity at full capacity.

Since velocity also varies as the square root of the slope and inversely as the roughness, the effect of doubling the diameter will be worse for steep, smooth conduits than for rough ones on mild gradients. In fact, the disadvantage of high velocity in large

[1] California Highways and Public Works, November, 1942.

[2] Box dimensions are "span times depth" in that order.

culverts can be offset in many cases by roughening the walls or stepping the grade.[3]

Most important, however, is the freedom of outlet. If the outlet is submerged, the large culvert will flow full to the outlet, then outfall in a decelerating transition through the wider channel. But if the outlet is free, the culvert will outfall in an accelerating transition, as illustrated in **Fig. 29 c, e, g**[4] and estimated for typical cases in **Fig. 30.**[4]

From these general considerations, it may be concluded that cross-section area of large culverts should not be computed from formulae devised for small culverts, unless there is assurance that the outlet will be submerged.

Shape of Section

If the outlet is free, it is most important that the shape of the culvert section be selected with careful regard for the natural cross-section of the stream. Natural channels in rocky canyons may have width and depth nearly equal, but stable channels through softer materials are 5 to 50 times as wide as deep.

Economy demands some reduction of channel width at highway crossings. For bridges the reduction of main channel is seldom as much as 40 per cent, but greater reduction is practical for culverts, because of protection built into the structures. The greater the reduction, the more costly the protective appurtenances, so that there is, for each site, an economic limit to span reduction. This limit may be as great as 50 per cent of main channel.

In selecting the shape of wetted section, it is obvious that a circular section is the most economical for prefabricated conduits and a rectangular section (nearly square) the simplest to form on the job. This latter is economical up to a certain combination of span and earth load, beyond which it is cheaper to form a thin arch than to cast a thick top slab.

Now the natural section of most streams is a concave bed (varying from trapezoidal to parabolic) under a level water surface. Deforming the upper surface to the crown of a pipe or an arch is not natural and should not be attempted without weighing the consequences. At the culvert entrance, the consequences are not severe—backwater, reduced velocity of approach, moderate eddy action, debris entrapment. But at a free outfall the consequences are usually damaging—draw-down flow, increased velocity of retreat, erosion of banks by direct or eddy currents, scour by high bed velocities in supercritical flow.

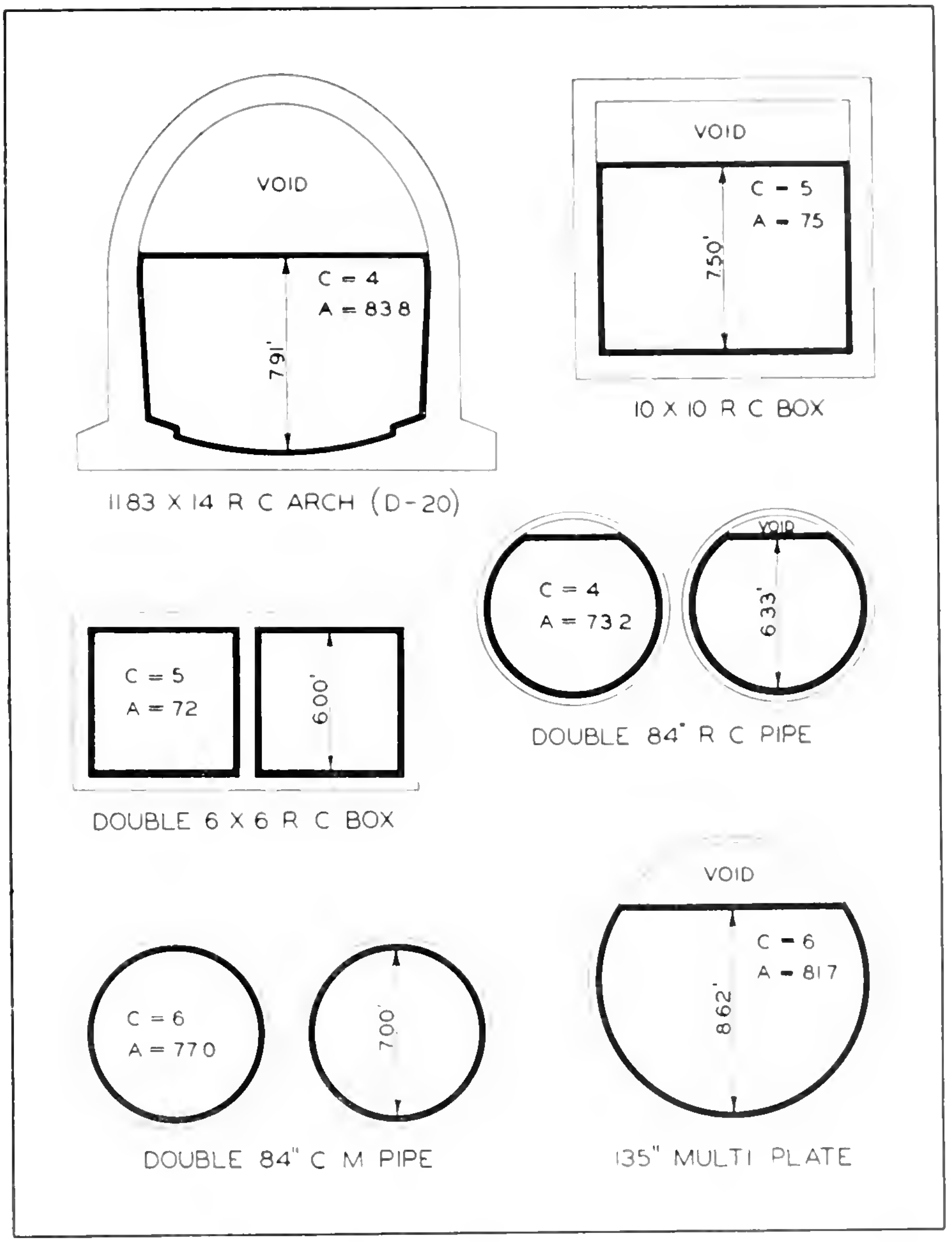


FIG. 53. Application of rated waterway limitation to typical free-outlet culvert sections

Structural Voids

The answer, of course, is that the archway of a free culvert is primarily a structural void instead of a waterway. Part of it may be usable for waterway or driftway, but it is careless practice to determine waterway area requirement from, say, the Talbot formula, then select an arch culvert with barely that requirement.

Structural voids are not limited to arch culverts. The upper portion of a large pipe culvert is similar in shape and primary function. Even for rectangular sections, the crown slab may be elevated to serve as roadway deck, leaving a structural void.

As thus defined, the structural void is readily apparent, but determination of the boundary between usable waterway and the void is more difficult. The committee proposes two steps: first, an arbitrary boundary for preliminary studies and estimates and, second, a method of analysis for final design.

[3] *Loc. cit.* p. 8.
[4] California Highways and Public Works, January, 1943, p. 6.

Rated Waterway

The first step is to define a "rated waterway" for each large culvert with free outlet as the equivalent usable waterway (exclusive of structural void) for the culvert under the most favorable conditions. If the culvert is laid on sub-critical gradient and if the downstream channel is reasonably secure against erosion and scour, then the tentative selection of a section by its rated waterway may be confirmed by the hydraulic analysis.

The rated waterway of any culvert section is determined arbitrarily by the formula:

$$D_{rw} = \frac{b + c\sqrt{n}}{2}$$

Where D_{rw} is the depth of rated waterway above the flow line, **b** is the culvert span, **n** the number of spans (usually one) and **c** depends on type, as follows:

c = 4 ft. for R. C. arches and pipe
c = 5 ft. for R. C. boxes and C. M. arches
c = 6 ft. for C. M. pipe

Tables 4-7 show the application of this arbitrary formula to standard large culverts. In these tables it will be noted that the reduction of working area is greatest for high and narrow sections and that it diminishes for rough-wall or multiple conduits. **Figure 53** compares the shapes of waterway and extent of voids of six sections which are nearly equivalent.

Effect on Arch Design

The reduction is properly severe for the standard concrete arches **(Table 4)**. The high and narrow sections with smooth walls, for which a low value of C is applicable, are rated at 62 to 84 per cent of gross area, the percentage rating being less for the larger sections.

These sections were designed to give gross area at least cost. Redesign to obtain rated waterway at least cost would result in flatter arches—especially under low or moderate fills. This could be accomplished by decreasing the rise-to-span ratio of the arch (requiring a heavier arch ring) or lowering the spring line.

The Myers Creek Culvert **(Figure 54)** illustrates the use of such proportions to obtain structural and hydraulic efficiency at the same time. Its rated waterway (last item of **Table 4**) is 93.6 per cent of its gross area. Compare this with the item above it, the Salt Creek Culvert **(Fig. 35a)**,[5] for which the rated waterway is only 53 per cent of the gross area.

Table 4

Rated Waterway for Free Outlet R. C. Arch Culverts (c = 4, n = 1)

Standard No.	Span ft. =b	Gross depth ft.	Rated depth =Drw	Gross area Sq. ft.	Rated waterway Sq. ft.
D13	4.36	5.44	4.18	20.0	16.9
D14	5.38	6.42	4.69	29.9	24.5
(1)	5.88	7.21	4.94	35.8	28.0
D15	6.55	8.00	5.27	44.1	33.1
D16	7.55	9.25	5.77	59.1	40.5
D17	8.46	10.33	6.23	73.8	48.8
D18	9.32	11.42	6.66	89.9	57.8
D19	10.08	12.33	7.04	105.0	66.0
D20	11.83	14.00	7.91	134.6	83.8
D21	14.00	14.97	9.00	171.6	119.1
(2)	16.25	20.58	10.12	285.3	151.2
(3)	21.00	14.42	12.50	250.7	234.7

(1) Drawing C-1018-2, 1-Men-1-B; (2) Bridge 6-23, Salt Creek; (3) Bridges 58-261-S, Myers Creek.

For each of these special designs, shape was determined entirely by height of embankment above the arch, being 73 feet above flow line at Salt Creek and 23 feet at Myers Creek. The ideal shape of the latter would not have been practical under a high embankment.

Table 6

Rated Waterway for Free Outlet R. C. Box Culverts (C = 5, n = 1, 2, 3)

Size	Single box: Gross area	Single box: Rated waterway	Double box: Gross area	Double box: Rated waterway	Triple box: Gross area	Triple box: Rated waterway
6x 6	36	33	72		108	
7x 7	49	42	98		147	
8x 7	56	52	112		168	
8x 8	64	52	128	120.6	192	
9x 8	72	63	144		216	
9x 9	81	63	162	144.6	243	238.4
10x 8	80	75	160		240	
10x 9	90	75	180	170.7	270	
10x10	100	75	200	170.7	300	280
12x 9	108	102	216		324	
12x10	120	102	240	228.9	360	
12x12	144	102	288	228.9	432	372

The conflict between hydraulic and structural arch shapes under moderate-to-high fills should be compromised. **Figure 55** compares the standard arch (a) with other general shapes which may prove more economical for free-outlet culverts. The flat arch (c) for low fills is essentially the shape of the Myers Creek culvert. Some intermediate design (b) should be most economical for moderate fills.

[5] California Highways and Public Works, January, 1943, p. 10.

Table 5

Rated Waterway for Free Outlet R. C. Pipe Culverts (C = 4, n = 1, 2)

Diameter inches	Single pipe (n=1): Gross area	Single pipe (n=1): Rated waterway	Double pipe (n=2): Gross area	Double pipe (n=2): Rated waterway
51	14.2	14.1	28.4	
54	15.9	15.6	31.8	
57	17.7	17.1	35.4	
60	19.6	18.6	39.3	
63	21.6	20.2	43.3	
66	23.8	21.9	47.5	
69	26.0	23.5	51.9	51.8
72	28.3	25.2	56.5	56.0
75	30.7	27.0	61.4	60.4
78	33.2	28.8	66.4	64.6
81	35.8	30.6	71.6	68.9
84	38.5	32.5	77.0	73.2

Adaptability of the multiple arch (d) for fills of any height should be tested. Use is not uncommon for low fills **(Figures 56 and 57)** where clearance is limited.

Table 7

Rated Waterway for Free Outlet C. M. Pipe Culvert (c = 6, n = 1, 2, 3)

Diameter In.	Single pipe (n=1): Gross area	Single pipe (n=1): Rated waterway	Double pipe (n=2): Gross area	Double pipe (n=2): Rated waterway	Triple pipe (n=3): Gross area	Triple pipe (n=3): Rated waterway
75	30.7	30.6	61.4		92.0	
78	33.2	32.9	66.4		99.5	
84	38.5	37.3	77.0		115.5	
90	44.2	42.0	88.4		132.5	
96	50.3	46.7	100.5		150.8	
102	56.7	51.5	113.5		170.2	
105	60.1	54.1	120.3	120.1	180.4	
108	63.6	56.6	127.2	126.2	190.9	
114	70.9	61.9	141.8	139.0	212.6	
120	78.5	67.3	157.1	151.7	235.6	
135	99.4	81.7	198.8	184.9	298.2	294.5
150	122.7	97.3	245.4	219.9	368.2	353.3
165	148.5	114.2	297.0	257.3	445.5	414.4
180	176.7	132.2	353.4	297.1	530.1	478.5

One definite start has been made. Culvert standard sheets D23 and D24 for plain concrete arch culverts each include tabulated columns showing gross and rated waterways for each standard section. The D23 and D24 sections were not modified to improve the rating, but the evaluation shown on these standards will point the way for modifications in the future.

Method of Hydraulic Analysis

It must be emphasized again that the "rated waterway" is a first approximation to design, which should be confirmed or corrected by hydraulic analysis. The objective is to determine stage and velocity at outlet, anticipating, as the next step in design, either (1) modification of section until velocity is tolerable or (2) protecting the culvert and roadway structure against intolerable velocity.

The general problem is that of accelerated flow in an open channel—controlled at inlet and free at outlet. The analysis should start with the assumption that flow will be critical just inside the culvert entrance. Using the design discharge, compute the critical stage, for which velocity head is half the mean depth. For this purpose, mean depth is the wetted area divided by the width of the free water surface.

Working upstream from the critical section, the entrance stage (including head of approach velocity) will be the energy head at critical sec-

FIG. 54. Myers Creek culvert on State Highway in Imperial County, a flat arch under a low fill

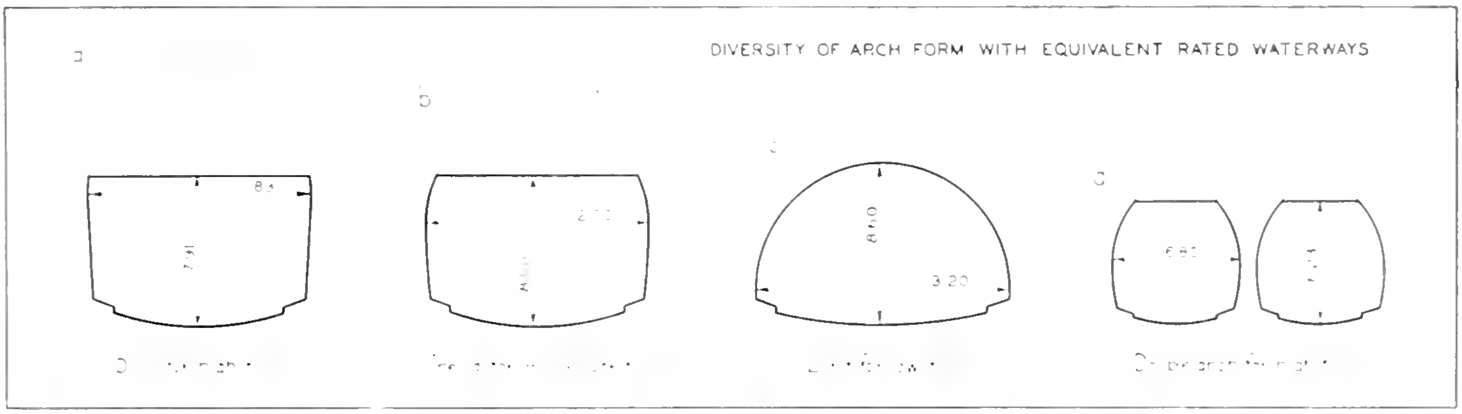


FIG. 55. Trend of arch design for least cost of rated waterway

FIG. 56. Las Flores Creek. Looking under bridge at double arch culvert of A. T. & S. F. Railway

FIG. 57. Quintuple culvert of rubble masonry and metal arches, Moosa Canyon on State Highway in San Diego County

tion plus an allowance for entrance loss.

Working downstream, the easiest procedure is to calculate the distance L_1 to a section somewhat smaller than the critical section, assuming that the mean slope of the energy line between two sections is the mean of the slopes at those sections. The method will be illustrated for a circular section, using **Table 8**, a chart (such as Scobey's) (1)[6] for Kutter's formula and the approximation

$$L = \frac{h_{e1} - h_{e2}}{s_1 - s_m}$$

For an example, assume a 72-inch R. C. pipe culvert 200 feet long on a slope of 0.02 and with free outlet proposed to carry 252 second-feet (= 10 ft. per sec. through 25.2 sq. ft. of its rated waterway, see **Table 5**). Dividing Q (= 252) by $D^{2.5}$ (= 88.2), the quotient, 2.86, may be used to interpolate the critical elements from **Table 8**, viz:

Critical velocity, $V_c = 4.70\sqrt{6} = 11.5$ ft. per sec.,
Least energy, $h_e = 1.067 \times 6 = 6.40$ ft.,
Critical depth, $d = .726 \times 6 = 4.35$ ft., and
Hydraulic radius, $R = .300 \times 6 = 1.80$ ft.

Using Kutter's n = .013 and these values for V and R, find the slope (S = 0.0043) of the energy line at this point. Since the culvert slope ($S_1 = 0.02$) is steeper, flow will accelerate and downstream sections will be smaller than the critical.

Take some smaller section for which elements are given in **Table 8**—e.g. that for which d = .604 D = 3.62 ft. In **Table 8** (shown in the third column, this page) the first 3 columns are computed for critical flow, but the last 3 columns are geometric relations independent of flow. Hence for the supercritical flow at this second section, R = .279 D = 1.67 ft., A = .495 D^2 = 17.82 sq. ft. and V = 252 ÷ 17.82 = 14.14 ft. per sec. Again using a Kutter chart, find $S_2 = 0.0072$.

Application of the approximation to find $L_1 = 23$ ft. is now obvious, with the detail shown on **Figure 58.** The figure is a profile summarizing a series of steps like the first. The steps continue until the sum of L_1, L_2, etc. exceeds the length of culvert, then the depth of flow at outlet can be interpolated and outfall velocity (V = 18.6 ft. per sec.) computed.

Justification for an analysis for such a design is now apparent. Assumption that the pipe flowed full at outlet would have given an outfall

(Continued on page 17)

Table 8

Critical Elements of Circular Sections

$\frac{Q}{D^{2.5}}$	$\frac{V_c}{\sqrt{D}}$	$\frac{h_e}{D}$	$\frac{d}{D}$	$\frac{R}{D}$	$\frac{A}{D^2}$
1.0	3.20	.579	.420	.222	.312
1.2	3.38	.640	.462	.237	.355
1.4	3.55	.698	.501	.250	.395
1.6	3.72	.752	.537	.261	.430
1.8	3.88	.805	.571	.270	.463
2.0	4.04	.857	.604	.279	.495
2.2	4.19	.907	.634	.285	.525
2.4	4.34	.956	.663	.291	.553
2.581	4.47	1.000	.6887	.295	.577
2.6	4.49	1.005	.691	.295	.579
2.8	4.65	1.053	.718	.299	.602
3.0	4.80	1.100	.743	.301	.625
3.5	5.20	1.220	.800	.304	.673
4.0	5.64	1.342	.848	.303	.710
4.5	6.12	1.468	.887	.300	.735
5	6.64	1.600	.918	.294	.753
5.5	7.18	1.740	.939	.289	.767
6	7.76	1.892	.956	.284	.773

[6] Numbers in parenthesis refer to bibliography at end of article.

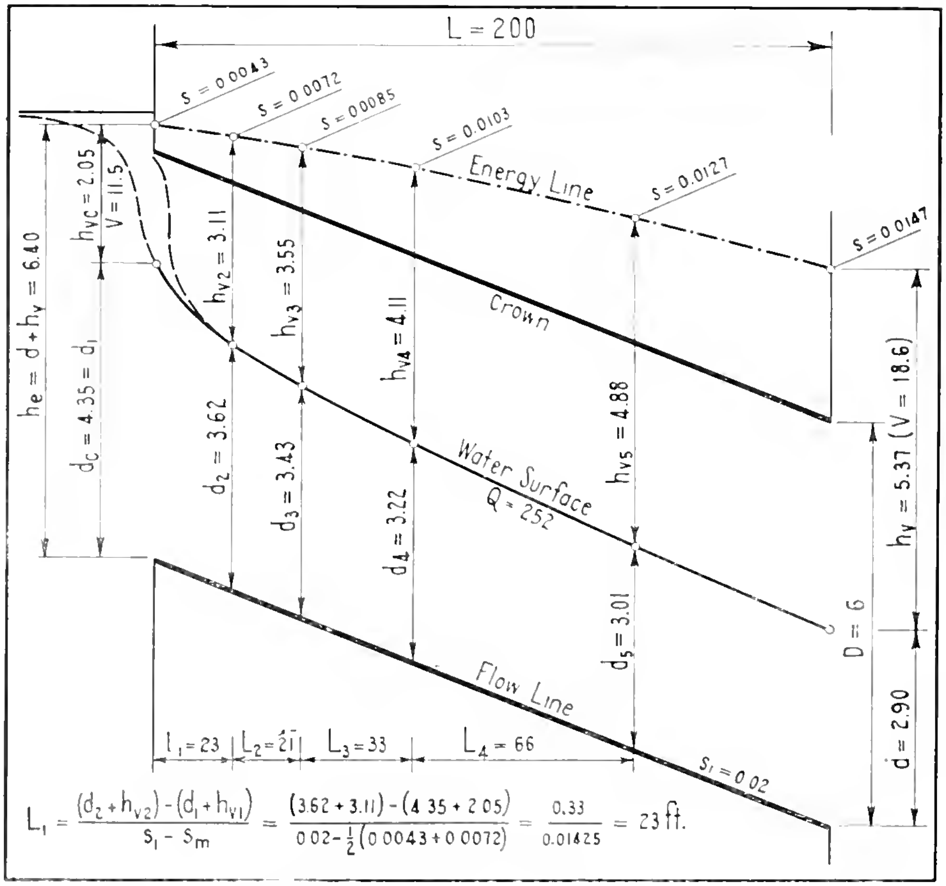


FIG. 58. Application of Table 8 and formula for non-uniform flow to 72″ R. C. pipe (Kutter's N = .013) culvert with free outlet

Bay Bridge Shows Low Accident Record Despite High Traffic Peaks

STUDIES of accident reports, traffic movement and physical conditions on the San Francisco-Oakland Bay bridge during 1942, which have been completed by the Division of Highways, reveal that in terms of vehicle miles traveled last year, the bridge shows four fatalities per hundred million vehicle miles as compared with eleven on the rural State highway system.

For the entire time the bridge has been opened, in the same terms, the bridge record is six compared with the rural State highway average during the last five years of 12.5.

Accident reports show that wilful disregard of fundamental rules of the road regarding proper speed, passing movements and adherence to designated lanes of travel and the astoundingly high percentage of drunken or had-been-drinking drivers, are the greatest contributing causes. Accidents resulting simply from confusion or mere inadvertence on the part of drivers make up only a small part of the total.

HAZARD POINT STUDY

During times of peak traffic movement, each lane on the upper deck of the span in one direction carries from 1,000 to 1,500 cars, and with traffic in this amount there is great need for the most complete control of its movement to assure a steady uninterrupted flow and to reduce the accident rate.

The record on the lower deck of the bridge shows a concentration of accidents at the Treasure Island entrance. This situation is under study at the present time in an endeavor to provide some method of traffic control that will alleviate the hazard at that point at least to some extent.

During the past two years, much thought has been given to improving the center marking on the upper deck and several trial installations have been made. All except one of the methods tried thus far have been discarded. The raised painted line now on a section of the bridge, or some modification of that design, seems to have some possibility of improving the visibility of the center marking particularly during rain storms. Light shields required by military authority to shield the bridge lights as a protection measure are now being installed.

Hope for betterment of the accident record would seem to lie in some more complete control of traffic, which would be accomplished by other than purely physical means.

HIGH SPEED CAUSE

Sixteen accidents, or 30 per cent of the lower deck total, occurred at the intersection of the Treasure Island roadway. A large part of these are the result of vehicles entering the danger zone at too high a speed. The use of traffic signals to reduce the hazard at this point is being studied by the Traffic and Safety Department of the Division of Highways.

Three fatal accidents with four deaths occurred during 1942, as compared to seven in 1941 with a death toll of ten. There was an increase in the number of personal injury accidents from 82 to 119, but the number of persons injured was only slightly greater, increasing from 169 to 189. It is evident that although the accident rate may have increased, the severity rate has decreased sharply.

The following tabulations of traffic accidents on the bridge during 1942 show the types of accidents and the contributing causes:

TRAFFIC ACCIDENTS

January 1 to December 31, 1942

UPPER DECK

	Crossed center line	Rear end	Hit bridge right side	Other	Total	Per cent
Total accidents	50	162	3	27	242	100
Driver drinking	17	28		3	46	19
Driver asleep	6	4	1	2	13	5
Curved roadway	2	1		6	9	4
Wet pavement	2	4		4	10	4
Fatal accidents	1	1		1	3	1
Injury accidents	26	55	3	6	90	37
Property damage only	24	105		20	149	62
Daylight accidents	22	81	3	14	120	50
Night accidents	28	81		13	122	50

LOWER DECK

	Crossed center line	Rear end	Hit bridge right side	Other	Total	Per cent
Total accidents	5	29	6	14	54	100
Driver drinking		1			1	2
Driver asleep						0
Curved roadway	1	2		2	5	9
Wet pavement	2	6		3	11	20
Fatal accidents						0
Injury accidents	1	11	1	6	19	35
Property damage only	4	18	5	8	35	65
Daylight accidents	3	24	4	14	45	83
Night accidents	2	5	2	..	9	17

TRAFFIC ACCIDENTS

January 1 to December 31, 1942

UPPER DECK

20 7% of all accidents were head-on.
66 9% of all accidents were rear-end.
1 2% of all accidents were hit bridge right side.
11 2% of all accidents were miscellaneous types.

LOWER DECK

9 3% of all accidents were head-on.
53 7% of all accidents were rear-end.
11 1% of all accidents were hit bridge right side.
25 9% of all accidents were miscellaneous types.

UPPER DECK

19 0% of all accidents involved drinking drivers.
34 0% of all head-on accidents involved drinking drivers.
16 0% of all rear-end accidents involved drinking drivers.
0.0% of all hit bridge right side accidents involved drinking drivers.
11.1% of all miscellaneous accidents involved drinking drivers.

UPPER DECK

24 4% of all accidents involved drinking or asleep drivers.
46 0% of all head-on accidents involved drinking or asleep drivers.
18 5% of all rear-end accidents involved drinking or asleep drivers.
33 3% of all hit bridge right side accidents involved drinking or asleep drivers.
18 5% of all miscellaneous accidents involved drinking or asleep drivers.

It was during the impanelling of a jury that the following colloquy occurred:

Judge: You are a property owner?

Prospective Juror: Yes, Your Honor.

Judge: Married or single?

Prospective Juror: I have been married five years, Your Honor.

Judge: Have you formed or expressed an opinion?

Prospective Juror: Not in five years, Your Honor.

"Young man," said the old one, severely, "when I was your age, I, too, thought I knew all. Now I have reached the conclusion that I know very little."

"Great Scot!" exclaimed the lad in astonishment; "has it taken you this long to find that out? Why, I knew it the minute I saw you!"

$1,000,000 Winter Highway Damage

By W. A. SMITH, Assistant Maintenance Engineer

U. S. 66 blocked by flood debris at railroad underpass near Gish, San Bernardino County. Railroad was also washed out

DAMAGE to State highway structures and facilities in excess of $1,000,000 occurred during the winter season just past. Nearly three quarters of this damage was in the Los Angeles and San Bernardino areas.

A large portion resulted from the single three-day storm January 21 to 23, when 5.58 inches of rain fell in the Los Angeles area and 7.23 inches in San Bernardino. It was reported that 28 inches of rain fell at Camp Baldy and 21 inches at Big Bear.

A second storm in April caused about $80,000 damage in the same area.

With such a heavy rainfall in the short period, it is not surprising that nearly every section of highway and, in fact, other types of transportation systems were closed to traffic for longer or shorter periods.

DEBRIS CHOKED SUBWAY

At Cajon Pass on U. S. 66, for example, the Gish subway was choked with debris due to scouring out of the highway well in advance of opening of the railroad.

nearby drainage structure. The embankment under the railroad tracks west of the subway was completely washed out.

Highway maintenance forces were able to start traffic moving over the

The most extensive damage occurred on State Highway Route 62 in San Gabriel Canyon, and the cost of restoration of channel paving in the Arroyo Seco will be the largest single item. Long sections of other routes were covered with mud and debris up to several feet in depth.

State Highway 188 washed out; temporary detour near Crestline, San Bernardino County

OCEAN SCOURED EMBANKMENT

At Camarillo on U. S. 101, the highway was blocked by eucalyptus trees. At El Morro Bay on State Highway Route 60, the ocean scoured out the highway embankment to the shoulder line and only prompt action by highway maintenance forces in placing heavy riprap prevented entire loss of the section of highway.

U. S. 99 was closed to traffic for several days due to washing out of approach to the Castaic Creek bridge.

Floods occurred at intervals in the southern part of the San Joaquin Valley, and most of the highways in parts of Tulare and Kern Counties were under water at one point or another. The most serious storm was on March 9 and 10, when one bridge was destroyed and eight damaged in this area. The most serious damage from a traffic viewpoint was at Poso Creek on U. S. 99, near Famoso Junction. Traffic must detour at this point for a period of three months while repairs are made.

MANY BRIDGES DESTROYED

During the several storms, other bridges were destroyed or damaged, including structures across Little Cow Creek and Oak Run Creek at Mile 20 in Shasta County; five spans of the Santa Ynez River bridge on Route 56 in Santa Barbara County; the detour bridge over the Salinas River on Route 56 in Monterey County; and complete loss of the bridge across Matilija Creek on Route 138 in Ventura County.

The damage as outlined does not include such work as repair of pavement which has been damaged by flooding. This work is usually done as part of regular maintenance operations and is not included in the estimate, although the total cost will add up to a considerable item.

Funds are not available for complete restoration of the highways at this time. Only sufficient work is being done to make them safe for travel at many points. The heavy damage placed a severe strain on the limited personnel and equipment, but on the whole the organization was fortunate that the damage was not more widespread.

Approach to Castaic Creek Bridge on U. S. 99 in Los Angeles County washed away

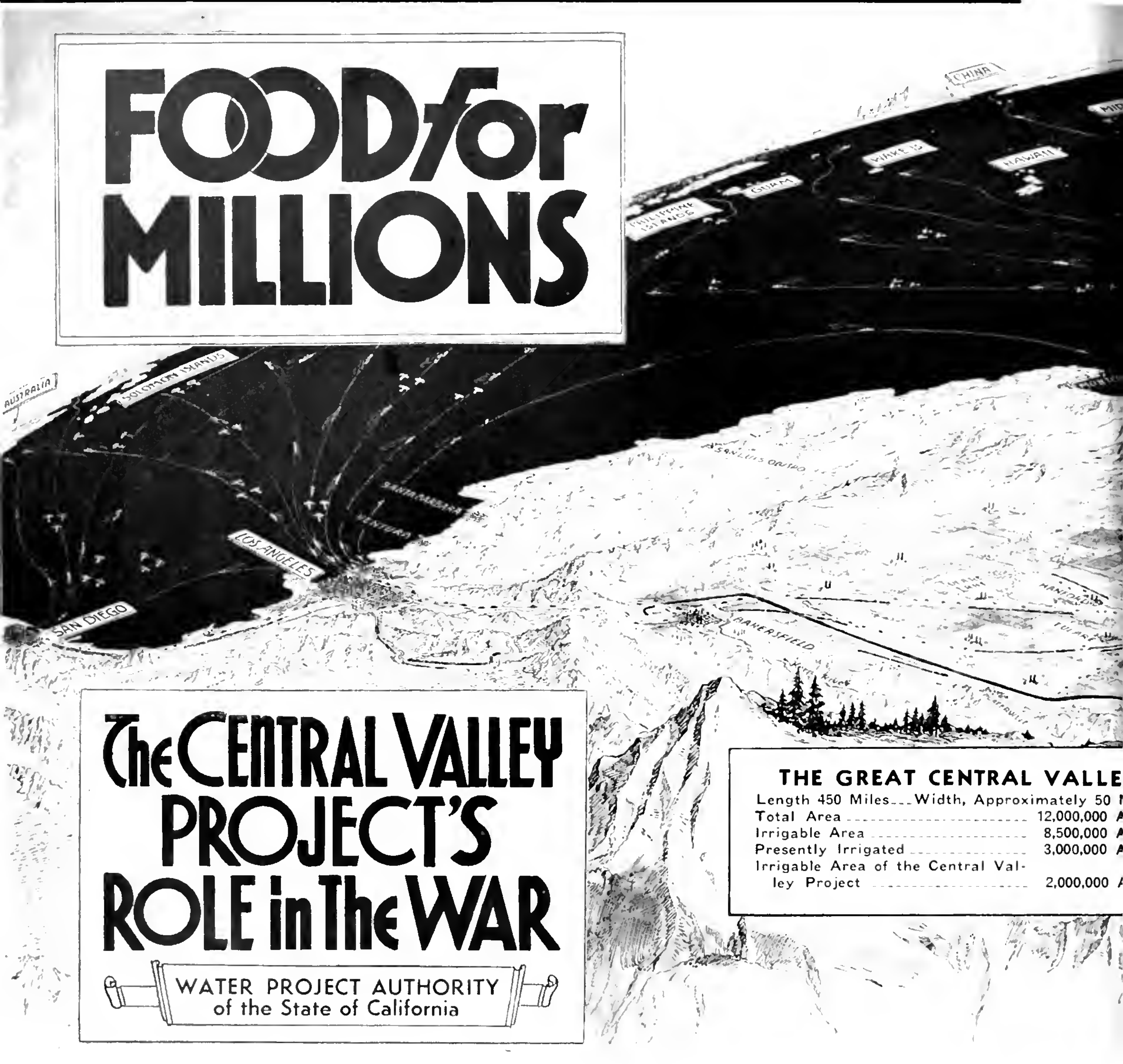
Roadway between bridges washed out in San Gabriel Canyon

One lane of approach to bridge over Santa Clara River on U. S. 6 damaged

FOOD for MILLIONS

The CENTRAL VALLEY PROJECT'S ROLE in The WAR

WATER PROJECT AUTHORITY
of the State of California



THE GREAT CENTRAL VALLE

Length 450 Miles___Width, Approximately 50 M

Total Area	12,000,000 A
Irrigable Area	8,500,000 A
Presently Irrigated	3,000,000 A
Irrigable Area of the Central Valley Project	2,000,000 A

Governor's Appeal Wins Approval

(Continued from page 1)

creased food production in California will ease this transportation problem.

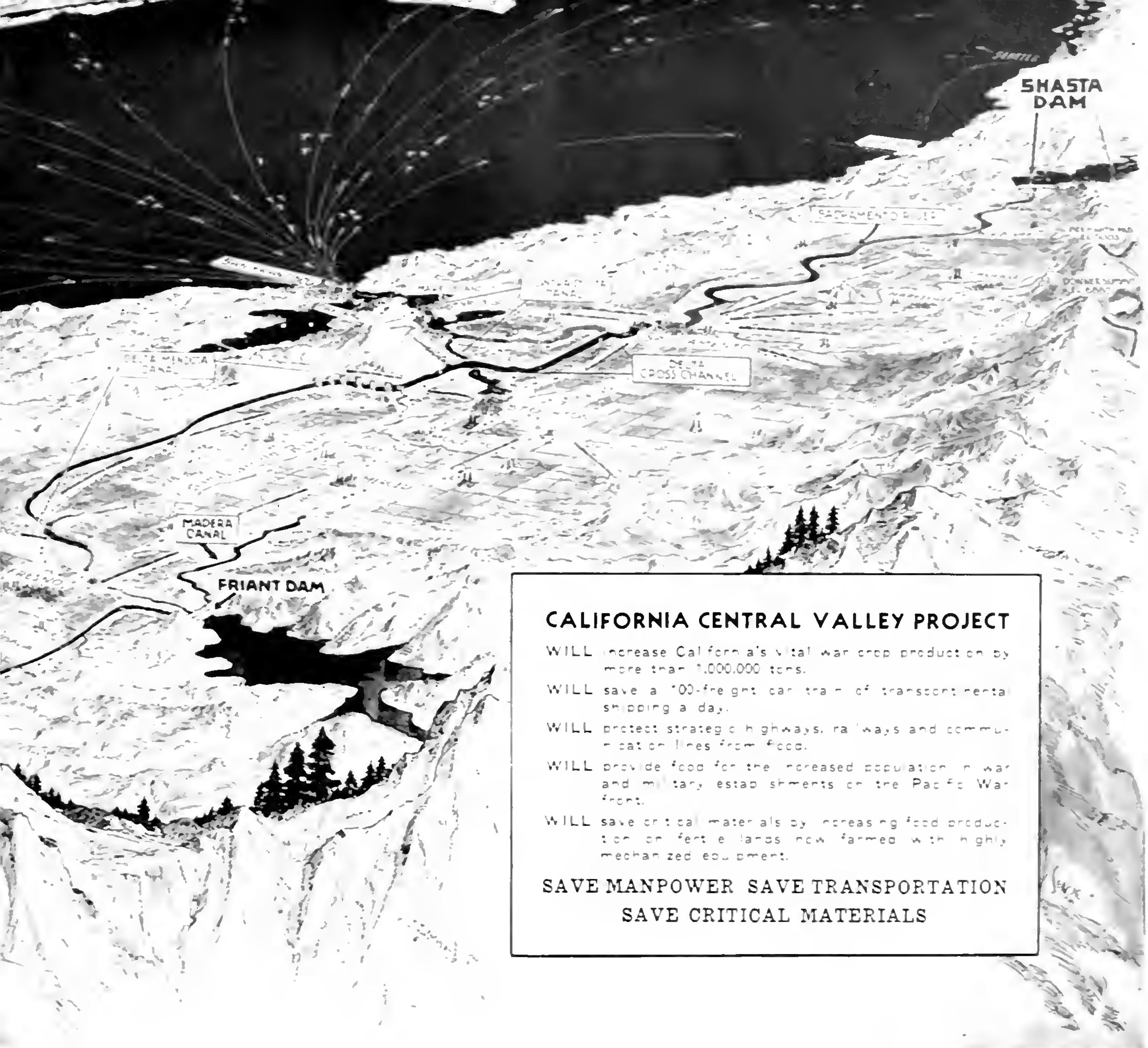
FRIANT CONTROL GATES NEEDED

"Certain features of the project could be completed within a year, and others within two years, which would be of incalculable aid to California agriculture. For example, the Friant Dam on the San Joaquin River is now complete with the exception of control gates. Some $16,-500,000 has been expended on this structure, yet today it is not capable of even serving the purpose of controlling floods. In its present status no water can be impounded. Installation of control gates in the dam would make possible the regulation of the water supply for 200,000 acres of fertile irrigated lands now planted to many war crops, and also a full dependable irrigation supply for 65,000 acres of land potentially capable of producing such crops.

"The Madera Canal, extending northward from Friant Dam, has been completed through eight miles of the only difficult terrain it must traverse. I am informed that the remainder of the canal could be completed for the most part as an unlined ditch in one year, using only a minimum amount of critical materials. This canal would serve 175,000 acres of lands within the Madera Irrigation District of which 83,000 acres are presently irrigated for the most part from wells.

CANAL WORK STOPPED

"Construction work on the Friant-Kern Canal, extending southward from Friant Dam, has not been started because of a stop-order of the War Production Board. The Bureau of Reclamation has stated that with a green light on priorities for



materials and equipment, this canal could be completed in a two-year period. This canal would bring a supplemental water supply to about 1,000,000 acres of irrigated land in an area where a severe deficiency in water exists.

"That the agricultural area to be served by the Friant-Kern Canal is highly important in the production of war crops, is shown by the fact that two of the counties it will serve—Tulare and Fresno—rank second and third in the value of food production among the counties in the entire United States.

"However, the effective operation of Friant Reservoir and the Friant-Kern and Madera canals is dependent upon construction of the Delta Cross-channel and the Delta-Mendota Canal, which will link the Sacramento Valley features of the project to those of the San Joaquin Valley. These two features of the project are essential for importation of water to replace water which will be impounded in Friant Reservoir and transported in the Madera and Friant-Kern canals.

"The Contra Costa Canal is completed except for an eleven-mile section to its proposed terminus near the city of Martinez. It is the only feature of the project at present actually in operation, and is supplying water to cities, war industries, and lands along the south shore of Suisun Bay. Its operation during a dry year, when water would be most needed, is dependent upon a supply from Shasta Reservoir furnished through the Delta Cross-channel. This canal could be completed within a year and would be capable of serving some 20,000 acres of agricultural land, as well as many important war industries.

"Completion of the Shasta and Friant dams would aid in the control of floods on the Sacramento and San Joaquin rivers. Valuable crop lands adjacent to both rivers, and perhaps more important, main rail and highway systems, are subject to damage from flood waters of these streams.

"California is recognized as the main base for operations in the War of the Pacific. Any possible steps that can be taken to protect her rail and highway systems, so vital to the movement of troops and supplies, should be of foremost importance and merit serious consideration by the agencies which now control priority ratings and by their rulings the appropriations from the Congress.

"On the other hand, in a dry year such as occurred in 1931, 1934, and 1939, water impounded behind the Shasta Dam would protect from the menace of salt water some 400,000 acres of lands in the Sacramento-San Joaquin Delta largely devoted to the growing of sugar beets, potatoes, asparagus, celery, and other vegetable crops. In dry years, crop losses in this area due to salt water invasion from San Francisco Bay have run into several millions of dollars.

POWER POSSIBILITIES AVAILABLE

"Also, lands in the San Joaquin Valley have suffered from inadequate water supply and the use of electricity for pumping in these dry years has increased tremendously. While consumption of electric energy mounts rapidly in dry years, hydro-electric production of necessity drops off due to depleted reservoirs. With California's expanding war industries and increased use of electricity, the margin of safety between production and consumption of electricity at this time is little more than adequate. If the present margin should be further reduced through expanded consumption, installation of the additional generating units at Shasta and Keswick dams would provide the logical solution of the problem.

"At this time, only two of the five generating units planned for Shasta are being installed and the three units originally planned for Keswick have been held up by War Production Board orders. When additional electric power is required in California, it should be pointed out that the additional power facilities which are an integral part of the project should be the first installed to meet such increased demands.

LAND REVERTING TO DESERT

"There is still another phase of this entire problem which merits consideration. I refer to the continued necessity of deepening wells used for irrigation, particularly in the Southern San Joaquin Valley where the overdraft on underground water supplies yearly grows more acute. Critical materials that could well be used for other purposes are required in the deepening of these wells and the attendant replacement of pumping equipment. Also, as the water level recedes, cost of electricity mounts in some cases to the point where it becomes uneconomic to farm the lands. Already some 60,000 acres of land that once were producing have reverted to desert.

"In view of the foregoing facts, I am firmly convinced the completion of the Central Valley Project is so essential to the war effort that I feel it incumbent upon myself as Governor of California to call these matters to your personal attention. I am certain that with your assistance the necessary priorities and appropriations can be obtained to make possible the use of this great project in California's endeavor to increase its production of foodstuffs vital to the Nation."

PRESIDENT ROOSEVELT'S REPLY

President Roosevelt wrote in reply:

"The most careful consideration has been given to your letter of March twentieth, in which you urge completion of the Central Valley development. The matter has been taken up with the War Production Board and the Federal Power Commission, and these agencies have thoroughly re-examined the project after consultation with the other interested Federal departments.

"The deferment of work on the Central Valley project, along with many others throughout the country, was found necessary by the War Production Board to meet a critical materials situation toward the end of 1942. While the problem of balancing our war budget in terms of materials and manpower is still an extremely difficult one, the current review of the irrigation, power and flood control features of the Central Valley development has led to the conclusion that further work can and should be authorized to the following extent:

"1. Completion of the Friant Dam with installations of the valves required for storing water but with continued postponement of the spillway gates;

"2. Completion of the Madera Canal;

"3. Completion of the concrete work on Keswick Dam.

STEEL SUPPLY CRITICAL

"The principal critical material required for this work is steel. The War Production Board hopes to be able to supply a majority of the necessary items from distress stocks, and in that way avoid interference with other urgent war production. The concrete work on Keswick Dam will make it possible to continue the contractor on the job for some months to come and will facilitate the ultimate completion of the project whenever it can be authorized. The completion of Friant Dam and Madera Canal should increase food production to some extent as early as 1944, with still greater benefits in 1945.

"Serious consideration is being given to the question of restoring the halted Shasta unit and the two Keswick units in terms of the fuel oil supply situation in the Pacific Coast. In view of the fact that this is a direct concern of the Petroleum Administrator for War, the matter has been placed before him. If he advises that the units are essential as an oil 'conversion' measure, we are hopeful that the necessary materials for their completion can be found.

"At the moment there are serious obstacles to authorizing the remaining irrigation features of the Central Valley development. They would require considerable amounts of critical materials and it would require a much longer period to make their benefits available than in the case of Friant Dam and Madera Canal.

"I fully share your view that this great public work in which we have already invested so much in money, material, and labor should be brought to completion as soon as feasible. The additional work which is now being authorized will permit the project to make important and reasonably prompt contributions to the war program, and I am hopeful that the matter can be reconsidered again at an early date so that still further work may be authorized."

GOVERNOR CLOSELY ASSOCIATED

Since his inauguration as Chief Executive of the State, Governor Warren has continued his close association with the activities of the Water Project Authority, attending its meetings and giving the newly appointed members the benefit of his experience on the Authority. The membership of the Authority now comprises, C. H. Purcell, Director of Public Works, Chairman; Attorney General Robert W. Kenny, Director of Finance John F. Hassler, State Controller Harry B. Riley and State Treasurer Charles G. Johnson. State Engineer Edward Hyatt is the Executive Officer and Deputy State Engineer A. D. Edmonston, Acting Secretary.

The Water Project Authority adopted resolutions urging completion of major irrigation features of the project and construction of the transmission line from Shasta to Oroville. Resolutions also were adopted by the California Farm Production Council and California State Board of Agriculture urging completion of the Central Valley Project to assist in the production of food and fiber in California.

These resolutions were sent to the President, Secretary of the Interior, Secretary of Agriculture, War Food

Administrator, War Production Board, Federal Power Commission, California Members in the Congress and congressional committees considering appropriations for the project.

AUTHORITY DELEGATES AT WASHINGTON

State Treasurer Charles A. Johnson, senior member of the Authority, State Engineer Edward Hyatt and Supervising Hydraulic Engineer Raymond Matthew, representing the Water Project Authority, went to Washington to present the case of the Central Valley Project to the Department of the Interior, Department of Agriculture, the War Food Administrator, Federal Power Commission and the House Subcommittee on Appropriations. They were materially assisted by Northcutt Ely, special representative of the Authority in Washington.

In these presentations it was shown what completion of various units of the project would make possible in the way of increased production. For example, installation of control gates on Friant Dam alone would provide some 600,000 acre-feet of additional water on the average annually for use in the San Joaquin Valley where at present there is a grave deficiency.

With improved regulation of the San Joaquin River by Friant Dam alone it has been estimated by the State Division of Water Resources that the better irrigation supply to approximately 200,000 acres downstream would make possible increased production on lands now farmed equal to bringing in 27,000 acres of new lands. The principal advantage of this production lies in the fact that the lands are now cultivated, the farm equipment is highly mechanized and most of the manpower needed for the additional production is already employed on the lands to be served.

The Madera Canal, extending from Friant Dam northward through Madera County, has been completed for a distance of eight miles, bringing it through the foothills to the valley floor. It stops just short of the lands that could be supplied with water. Completion of this canal will make possible an increase in farm production equivalent to bringing 30,000 acres of new class A lands into production. Under the WPB orders this work has been authorized.

Work on the Friant-Kern Canal which will extend from Friant Dam southward to Bakersfield, a distance of 160 miles, has not been authorized by the War Production Board. The area to be served by this canal is in great need of additional water supplies. The United States Bureau of Reclamation has submitted to the WPB a revised plan of construction for this canal which materially reduces the amount of critical materials required.

As in the case of the Madera Canal, the Friant-Kern Canal would serve lands now largely under irrigation but which have an inadequate water supply. It has been estimated that the increased production of critical war crops possible under this canal would be the equivalent of bringing 200,000 acres of new class A lands into production.

Through the Contra Costa Canal which runs along the south shore of Suisun Bay from Knightsen westward it has been estimated that an area of 16,000 acres can be brought under irrigation by 1945.

Thus completion of these units of the project would make possible an increased production of critical war crops in the Central Valley alone equal to bringing more than a quarter of a million acres of new lands into production. It has been estimated that these lands would produce more than a million tons of critical crops which now must be imported from outside sources.

Roughly this increased production in California would save the use of a 100-car freight train a day for every day in the year—a tremendous saving in transportation alone, which today presents one of the greatest bottlenecks in supplying the war of the Pacific. Much needed steel, tanks, guns, ammunition and other war materiel could be moved into the California supply bases if trains now required to transport food for the State's bulging civilian and military population were released through the increased production which is possible under the Central Valley Project.

Waterway Ratings Adopted

(Continued from page 10)

velocity of only 10 feet per second. Velocity of 21 feet per second would have been figured from an assumption that energy gradient equaled the culvert slope of 0.02.

Like computations for box culverts are much simpler and no table is needed. For the first step, the critical depth in terms of discharge, Q and span, b, is

$$d = \sqrt[3]{\frac{Q^2}{b^2 g}} = 0.314 \left(\frac{Q}{b} \right)^{2/3}$$

For arch culverts, the computations would be just like those for pipes if a table like **Table 8** of elements was available. It is recommended that such a table be prepared for each standard arch and placed on the detail drawing.

Conclusions of Committee

Summarizing its findings, the committee recommends generally that:

1. Culverts larger than 15 sq. ft. in section be classed as "large culverts."

2. The equivalent usable wetted section of a large culvert with free outlet be called its "rated waterway."

3. For preliminary estimates, the rated waterway may be determined from formula or **Tables 4-7** herein, for use if culvert section is selected on an area basis.

4. For final design, a hydraulic analysis may be advisable, particularly for the larger sections on steeper gradients discharging in erodible channels. Method of analysis is outlined and illustrated in the report.

5. Design of arch culverts should be more considerate of hydraulic elements. The multiple arch has hydraulic advantages, suggesting economy of more frequent use in design.

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October 1942—Debris [illegible] Culvert [illegible] California State Highway System
November 1942—Highway Culvert [illegible] and Slope [illegible] Practice
December 1942—Culvert [illegible] Headwalls [illegible] California Highway System
January 1943—[illegible] California Highway System
February 1943—[illegible]
March-April 1943—[illegible] Affecting Field Installation of Culverts

Western Highway Officials Discuss War Transportation Problems

HIGHWAY transportation matters of importance to the war effort and the postwar era were acted upon at the recent two-day annual meeting in San Francisco of the Western Association of State Highway Officials, which includes 12 States.

Officials of the California Highway Department and the eleven other western and southwestern States make up the organization. Robert Lee Bobbitt of San Antonio, former member of the Texas Highway Commission, presided at the conference as president before retiring and handing affairs of his office over to Fred J. Grumm, Assistant State Highway Engineer of California, who was elected to succeed him.

Director C. H. Purcell of the California Department of Public Works, State Highway Engineer G. T. McCoy, Mr. Grumm, and other California road officials took part in the meeting.

DEVOTED TO WARTIME PROBLEMS

The conference—the twenty-second annual meeting of the association—was strictly a wartime business session, President Bobbitt pointed out.

President Brady Gentry of the American Association of State Highway Officials and Chairman of the Texas Highway Commission; Thomas H. MacDonald, Commissioner of the Public Roads Administration, Washington; G. Donald Kennedy, Vice President of the Automotive Safety Foundation and president last year of the American Association of State Highway Officials, also Washington, and other wartime highway road and transportation officials, addressed the meeting.

President Bobbitt announced that wartime highway transportation problems would be the chief topic, since the first objective of everyone, of course, is to win the war. At the same time, however, he added, State road officials are working on practical plans for highway rehabilitation and development in the postwar period because highways will play a major part in that era and will go far to help bring a sound, prosperous, peace-time period.

Highway development on a vast new scale will be a chief asset for economic prosperity in the postwar period when development of all types of transportation will be tremendous. Highways, airways, railways, and waterways all will have their place and will be dependent upon each other.

POSTWAR BUILDING PROGRAM

More than 80 per cent of every dollar spent for highway construction goes for employment. Thus, highway projects by State Highway Departments can do much to ease the transition from war to peace tasks, will employ hundreds of thousands of persons, and will help take care of the necessary shift of employment when peace comes.

A chief subject considered by the Western Association of State Highway Officials' meeting was the postwar highway and road building program by the States. As recommended by the American Association of State Highway Officials to Congress, this would provide for a $1,000,000,000 per year distribution among the States of road users' tax revenues as Federal highway aid during the first three years of the postwar period.

COVERING RESOLUTIONS PASSED

Action was taken at the meeting designed to assist in early passage of Congressional legislation to authorize this program in order that work may start as soon as the war ends and the transition to peacetime begins.

A number of resolutions covering this and other recommendations made by the speakers were later adopted.

A recommendation that the transportation problem in California, Oregon, and Washington be considered a war-emergency will be made to the War Production Board by Thomas H. MacDonald, Chief of the Public Roads Administration in Washington, D. C., in the hope that present restrictions imposed by military necessity on highway construction will be lightened.

MACDONALD CITES TRUCK EFFICIENCY

Commissioner MacDonald told the delegates that speed and flexibility are characteristics which give to truck transportation an indispensable wartime function in the long haul field, supplemental to that of rail transportation.

"The movement of war goods is characterized by urgency and sudden changes in plans, requiring, in many cases, a form of transportation more flexible than that offered by railroads with their long trains and rigid schedules," MacDonald said. He added that he has completed a survey in California, Oregon, and Washington, to determine the importance of

Fred J. Grumm Elected President of W. A. S. H. O.

Fred J. Grumm, Assistant State Highway Engineer of California, was elected president of the Western Association of State Highway Officials at the concluding session of the twenty-second annual meeting at San Francisco, succeeding the retiring president, Robert Lee Bobbitt of San Antonio, Texas. The association represents 12 western and southwestern states.

Bernard Touhey, State Highway Engineer of Arizona, was named vice president; W. L. Anderson, Utah, secretary-treasurer, and W. T. Holcomb, Nevada, assistant secretary-treasurer.

DeWitt Greer, State Highway Engineer of Texas, was elected chairman of the war and postwar roads committee, which will consist of one member from each state highway department in the association.

Resolution on Manpower and Equipment Shortages on Highway Work

Resolution No. 3 passed by the Western Association of Highway Officials at its recent meeting reads as follows:

"Whereas, Adequate maintenance of highway facilities is a critical problem, not only from the standpoint of providing service to assential war-time traffic, but likewise in connection with the conservation of vehicles, parts, and tires to maintain the requisite transportation service to our civilian economy; and

"Whereas, The western States are handicapped by shortage of manpower, by shortage of maintenance equipment, and by difficulty in obtaining necessary materials and equipment parts; and

"Whereas, Necessities of war economy have curtailed new highway construction, which makes replacement of wornout highway facilities almost impossible during this emergency; now, therefore, be it

Resolved, That the Western Association of State Highway Officials, meeting in San Francisco, California, on June 3 and 4, respectfully request that consideration by the War Manpower Commission, the Selective Service Authorities, and the War Production Board be given to the problem of the need for manpower to maintain and operate the highway transportation system and to the simplification of the procedures for obtaining materials and equipment needed to keep highway facilities in good condition; and be it further

"Resolved, That a copy of this resolution be presented to the national and regional heads of the War Manpower Commission, War Production Board, the Selective Service Authorities, and the Transportation Corps of the United States Army."

highway transportation in wartime economy.

TRUCK TRANSPORT FASTER

"The average speed of trucks over long runs," MacDonald said, "such as, for example, from Seattle to San Francisco, is only slightly, if any, lower than that of the fastest passenger trains, and the elapsed time between pickup and delivery is much less than for any express service.

"C. H. Purcell, Director of the California Department of Public Works, submitted a number of examples, including one concerning boiler tubes shipped by truck from Oakland to Seattle in 30 hours to effect emergency repairs to a transport.

"In another case, cited by Mr. Purcell, a carload of special powder consigned to the Benicia Arsenal was delayed in transit and located in the Roseville freight yards of the Southern Pacific Company. Arrangement was made to haul this material from Roseville to the Benicia Arsenal, a distance of 75 miles, by truck overnight. The powder was then placed in ammunition and the ammunition shipped by truck to San Francisco in time to meet a transport sailing for a Pacific combat zone. It is estimated that this movement would have required about seven days by rail, owing to freight congestion.

"Chief Engineer R. H. Baldock of the Oregon State Highway Department reported that 11,487 pounds of cast iron pipe which left the Puget Sound Navy Yard at Bremerton, Washington, by truck on the morning of April 10 had to arrive at the Navy Overseas Terminal at Alameda before noon the next day and made the entire distance in less than 36 hours elapsed time.

"Following the recent Mississippi floods, the War Production Board saw fit to declare the problem of highway, bridge, and levee repair in the flooded area an emergency, which permitted the restrictions on road building and critical materials to be lifted for the purpose of restoration work.

"I am hopeful that we can convince the War Production Board that the transportation problem on the West Coast is also an emergency, requiring more flexible regulations governing highway construction and maintenance."

Formula Approved for Post-War Fund Apportionments

The following resolution was passed by the Western Association of State Highway Officials at the recent twenty-second annual meeting:

"Whereas, The American Association of State Highway Officials has recommended that Congress authorize one billion dollars per year for each of the first three post-war years, said money to be apportioned to the various States on the basis of a formula giving one-half weight to population, one-quarter weight to area, and one-quarter weight to mileage of post roads; and

"Whereas, It appears quite necessary for all States to present a united front to the Congress; now, therefore, be it

"Resolved, That the Western Association of State Highway Officials endorses and approves the amount recommended and the proposed method of apportionment; and be it further

"Resolved, That the Western Association of State Highway Officials has every confidence in the Executive Committee of the American Association of State Highway Officials and compliments and thanks the Executive Committee for the able manner in which it is handling this problem; and be it further

"Resolved, That the Secretary of the Western Association of State Highway Officials be instructed to transmit a copy of this resolution to Senator McKellar of Tennessee and to the Honorable Mr. Robinson of Utah, the authors of S-971 and HR-2426, with a request that S-971 and HR-2426 be passed as submitted, and that a copy of this resolution likewise be forwarded to Mr. Brady Gentry, President of the American Association of State Highway Officials and Miss Helen Whitaker, Acting Executive Secretary of the American Association of State Highway Officials."

Report on Highway Maintenance Equipment and Rental Procedure

By T. H. DENNIS, Maintenance Engineer

The following article is the second installment of a condensed report of the Sub-Committee on Highway Maintenance Equipment appointed by the Highway Research Board in 1940 to make a specific study of various types of equipment available or in use in performing highway maintenance work with a view to recommending the most suitable and practicable equipment for specific maintenance operations and the establishment of uniform equipment rental procedure throughout the United States. The report represents two years' work by the sub-committee members, T. H. Dennis, Chairman; A. A. Anderson, Portland Cement Association; H. K. Bishop, Chief of Construction, Public Roads Administration; B. E. Gray, Chief Engineer, Asphalt Institute; J. E. Lawrence, State Highway Maintenance Engineer, Massachusetts; Rex M. Whitton, State Highway Maintenance Engineer, Missouri, and was presented at the recent convention of the Board at Detroit. The pictures shown illustrate type of equipment only and the type is not restricted to any particular product. The first article appeared in the issue of December, 1942.

RECOMMENDATIONS received for the different size motor graders covered, in general, two classes, namely the 35 to 55 H.P. with 10-foot to 12-foot blade and the 60 plus H.P. with 12-foot to 14-foot blade. There is apparently no definite explanation of this classification other than the distinction indicated by the length of blade. The 14-foot blade, incidentally, is not standard and is probably accomplished by special extensions.

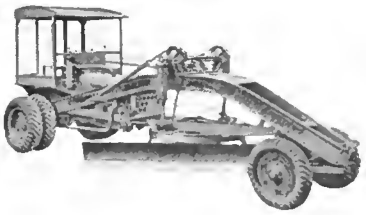

FIGURE 19

The motor grader is recommended above all other blading units for normal requirements. It is also adaptable to snow and ice removal

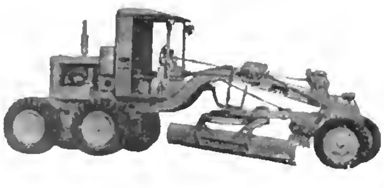

FIGURE 20

operations within its capacity. For this particular work the 45 to 65 plus H.P. unit is the most popular and is operated either with the blade or a "V" type snow plow attached to the front end. For ice removal a saw tooth blade is recommended.

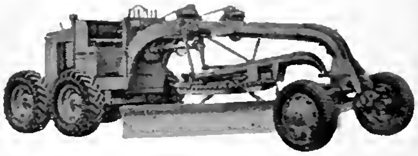

FIGURE 21

Length of Blade	Max. B.H.P. Not less than	Single Drive Shipping Weight*	Single Drive Tires	Tandem Drive Shipping Weight	Tandem Drive Tires
10′	31**	9,500	12.00x24	13,250	10.00x24
12′	34**	15,000	13.00x20	16,000	11.00x24
12′	62**	18,500	13.00x24	19,300	13.00x24
10′	32***	11,000	13.00x20	13,200	10.00x24
12′	50***	15,800	14.00x20	17,500	12.00x24
12′	65***	18,000	13.22x24	20,000	13.00x24

*Includes Scarifier. **Gasoline. ***Diesel.

The motor grader should be power controlled and should have not less than four speeds forward with a high gear speed at governed speed of engine not less than 10 miles per hour. It should be equipped with service brakes on at least two of the driving wheels with a hand operated brake for parking or emergency. The scarifier attachment should be mounted independently of the blade and with separate controls so that either the blade or scarifier may be operated separately or simultaneously. The scarifier teeth should be spaced not more than 4½ inches on centers and should be held in the block by means of wedges or keys. The wearing joints should be fitted with take-up bear-

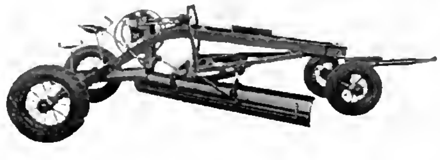

FIGURE 22

Equipment Rental

(Continued from December issue)

STATES AGREE

It may be assumed that in States where the cost of fuel and lubricants and other operating items are not included as part of the rental rates, such charges are distributed directly to the cost of the work. On that assumption there is very substantial agreement among the 33 States as to the items which should be included.

The inclusion of charges for fuel and lubricants as part of the rental rates presents little difficulty. There is no question but that the inclusion of these items in the rental rate would permit a more accurate distribution of the cost of work than is the case when fuel, oil and other lubricants are delivered in bulk and distribution of the cost thereof is made to road sections on a mileage or some other fixed basis. This is not the case with the labor engaged in servicing and operating the equipment.

Maintenance crews are generally organized and trained to perform the routine as well as special work within their sections. Obviously each section is not fully equipped for all such operations since much of it is either intermittent or seasonal.

(Continued on next page)

ıgs to compensate for wear, particularly y the blade-lift control.

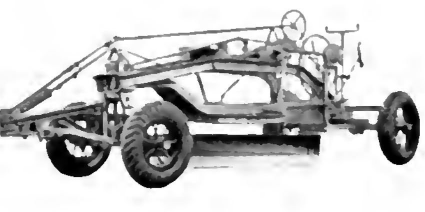

FIGURE 23

ength of Blade	Min. Weight Less Scarifier	Power Unit Required Tractor Size H.P.	Truck Size
8'	1,400	25	1½ to 2 ton
8'	3,300	25	2 to 5 ton 4-wheel drive
8'	5,800	40	2 to 5 ton 4-wheel drive
10'	7,300	45	2 to 5 ton 4-wheel drive
12'	9,500	60 plus	2 to 5 ton 4-wheel drive

The tow type blade grader should be neumatic-tired, hand operated, leaning-/heel* high lift type, equipped with a teerable* hitch. The wearing joints hould be fitted with take-up bearings to ompensate for wear, particularly the lade-lift control. All gears requiring onstant lubrication should be enclosed in il-tight cases and all bearings protected rom dust.

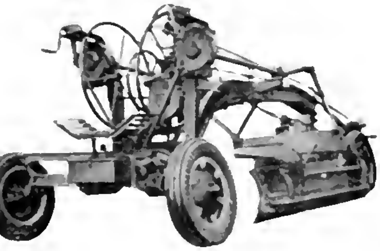

FIGURE 24

The scarifier attachments* should have ot less than five teeth, and should be nounted separately from the blade with eparate controls so that either the blade r scarifier can be operated independently r simultaneously as desired. The scarier teeth should be secured in the block y means of wedges or keys. The open pace between teeth should not exceed 5 nches.

Mudjack

The mudjack is used in all but the lountain States where there is a omparatively small amount of conrete pavement. On badly warped labs the mudjack has proven effecive for corrective work. Practice aries—in some instances, premixed sphaltic material is used for levelng rather than attempting to restore the slabs to their original positions; and in others, the premix is laid as a temporary measure pending final restoration to grade with the mudjack at which time the patch is removed.

* Not applicable for 1,400 minimum weight raders.

Equipment Rental

(Continued from preceding page)

As a result equipment is transferred from place to place as the need arises. Equipment rented on an operated basis under such conditions would necessitate a uniform rate which might conflict with the classification and pay scale of the particular crew. Likewise the permanent assignment of the operator to the equipment might not always be either economical to the maintenance organization or fair to the equipment operator.

RENTAL SYSTEM FAVORED

The majority opinion favors a rental system which includes depreciation, repairs and upkeep, plant and storage, and all operating costs except wages of operator. From a cost accounting viewpoint, such a system permits a day by day cost distribution on the basis of actual use of equipment. It simplifies the daily accumulation of expenditures so that the men in charge can readily ascertain the status of their job funds at any time.

A study of data furnished by the States shows the variety of methods followed in calculating rates and a wide range in the rates for similar units of equipment.

There is also a wide variance in the basis on which rates were established. For instance, rates were reported as being on an hourly, daily, weekly, monthly, mileage and seasonal basis. One State reported a seasonal rate for its snow plows and a second State reported a weekly rate for two water pumps. A number of States use either a per mile or monthly basis for automobiles and a monthly rate for graders and similar equipment.

BASIS FOR RATES

By grouping like equipment and neglecting incidental differences it was ascertained that the following basis for rates prevailed among the 33 States reporting:

(Continued on next page)

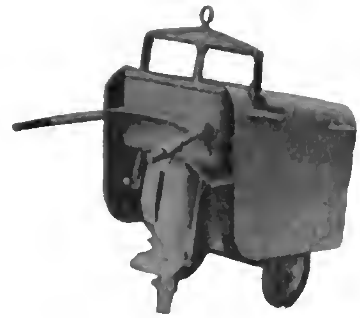

FIGURE 25

The two wheel pneumatic-tired cart type mudjack (Figure 25) should have a hopper capacity of approximately 4 cubic feet with full skirted guard. The height should not exceed 36 inches. The mud pump should be the single piston type with rubber ring built-in inlet valve and capable of producing 100 pounds pressure per square inch. The mud valve should be the floating ball, self-cleaning type.

The unit should be powered with an air-cooled gasoline engine and should weigh approximately 500 pounds.

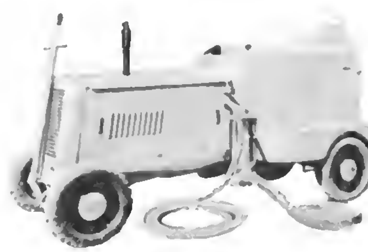

FIGURE 26

The large type mudjack (Figure 26) should have a capacity of approximately 12 cubic feet and should be mounted on a four-wheel pneumatic-tired trailer. The mixing unit should consist of a chamber containing a paddle type mixing shaft with sealed antifriction bearings and independent mud glands. The mud pumps should have rubber ring pistons and built-in inlet valves all capable of safely withstanding 250 pounds pressure per square inch. The mud valves should be the floating ball self-cleaning type. A two-way valve should be provided to permit use of two hose lines. The water supply should consist of at least a 1-inch rotary type pump having a capacity of 20 gallons per minute. The unit should be powered with at least a 25 H.P. gasoline engine, radiator cooled. The complete unit will weigh approximately 5,000 pounds completely equipped with the necessary hose and nozzles.

The type of equipment [illegible] for snow removal varies with local conditions. The [illegible] straight blade and "V" type [illegible] plows and rotary plows.

The push plow [illegible] [illegible] 24 [illegible] truck speeds of 12 [illegible] [illegible] [illegible] [illegible] [illegible] less than [illegible]

The "V" type [illegible] [illegible] approximately [illegible] [illegible] truck speeds [illegible] six miles per hour. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] necessary.

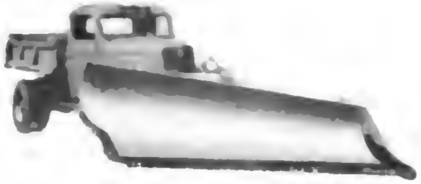

FIGURE 27

FIGURE 28

FIGURE 29

The [illegible] snow plows (Figure 27) should [illegible] 10 to 12 feet in length and weigh [illegible] pounds [illegible]

Equipment Rental

[illegible]

Basis of Applying Rates	Percentage of Units Reported
Hourly	59 1
Daily	15 9
Weekly	0 1
Monthly	20 3
Mileage	4 4
Seasonal	0 2
	100 0

The [illegible] per cent that [illegible] rental on an hourly basis was [illegible]

79 [illegible]	favored an hourly rental to cover all operating costs except operator.
12 [illegible]	favored an hourly rental to cover [illegible] repairs and upkeep.
1 [illegible]	favored an hourly rental to cover [illegible] costs exclusive of [illegible] operator.
[illegible]	favored an hourly rental to cover all [illegible] costs [illegible]

These percentages are representative [illegible] reported [illegible]

SUMMARY

[illegible] States and [illegible] subject [illegible]

[illegible] States [illegible] [illegible] [illegible] from [illegible]

[illegible]

ng the push frames. The reversible type plows (Figure 28) should be at least 10 feet in length and weigh approximately 1,400 pounds including the push frame. The "V" type plows (Figures 29, 30 and 31) should have cutting edges at least 8 feet in length, and will weigh from 1,500 to 2,200 pounds including the push frame but without the wing attachment. The wing attachment which is most generally used on the heavier type of plow should be about 10 feet in length and will weigh approximately 1,100 pounds including attachment frame.

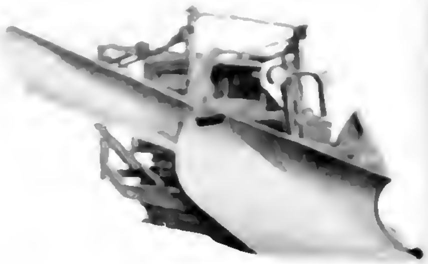

FIGURE 30

FIGURE 31

The push frame or under frame hitches for the light duty plows (1,500 pounds or less) should be adjustable and interchangeable on the 1½ to 2 ton two-wheel drive trucks. The heavy duty snow plows should be hinged ahead of the front axle or pushed from a bracket in the middle of the frame by push members hinged to the front axle. The plows should be supported on adjustable type runners with replaceable shoes, and controlled from the cab by a hand operated hydraulic lifting device. The plows should also be equipped with a hinged spring mounted deflector.

FIGURE 32

The rotary type snow plow should be designed so that the snow will be forced into the rotor or rotors. The plow should be mounted on a heavy duty truck, preferably driven from both the front and rear axles. In general a separate engine should be provided for operating the snow removal mechanism in addition to the engine that propels the truck. Under certain conditions where snowfall is comparatively light, the plow mechanism may be operated from the truck motor by means of a power take-off and reduction gears.

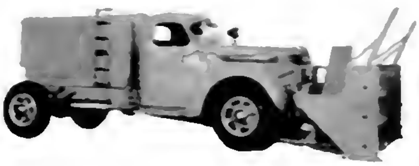

FIGURE 33

The plow should be capable of cutting an 8-foot cleared width and should be designed so that all loosened snow or slough from either opening, widening or windrow clean-up operations, should be forced into the rotor and thereby removed from the cleared strip. Raising and lowering the plow should be accomplished by means of a hydraulic lifting device with hand controls located in the truck cab. The cutting edge clearance should be regulated with an adjustable runner equipped with a removable shoe. The plow should be capable of clearing the snow down to the road surface and have possible vertical clearance range of at least 12 inches.

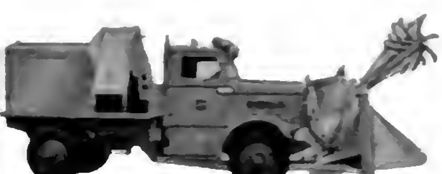

FIGURE 34

The plow should be equipped with adjustable deflector chutes that will permit directing the discharge either to the right or to the left. The plow should be designed so that a power operated attachment may be installed which may be used to break down drifts to within range of the plow.

Rollers

The pneumatic-tired roller is recommended for compaction of oiled gravel, road mix, plant mix and retread surfaces. It is also used to a lesser extent on other types of surfacing. The five to 10-ton three-wheel rollers are generally accepted as the "all-around" unit, apparently meeting any and all rolling requirements. The third selection is the two to five-ton power-driven portable roller closely followed by the two to five-ton portable new type. Due to their portability these latter two units are particularly suited to scattered patch work. The five to 10-ton tandem ranks fifth in preference, the five-ton unit being generally used more on routine maintenance work.

The pneumatic-tired roller should consist of pneumatic-tired wheels of equal size and diameter with an effective rolling area of not less than 60 inches. The frame should be rigid construction and provided with a loading platform or body suitable for carrying ballast. The front axle should rotate around a king pin so located that the roller may turn within a minimum circle. The roller should be designed to carry sufficient load to provide not less than 325 pounds per inch of tire tread.

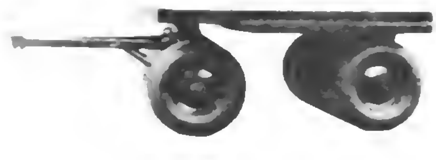

FIGURE 35

FIGURE 36

FIGURE 37

The three-wheel roller should be powered with a gasoline engine of at least four cylinders and have a transmission with two or more speeds in each direction. A water tank should be provided and all wheels fitted with an attachment for wetting. Suitable brakes should be provided capable of holding the roller on grades without the gears being engaged. The three-wheel roller most generally used for highway maintenance operations will weigh from 5 to 10 tons, approximately one-third of which should be carried by the front roll.

The motorized roller of the trailer type should have a drive roller drum not less than 24 inches wide and provide a pressure of at least 150 pounds per lineal inch when empty. It should be equipped preferably with an air-cooled gasoline engine and have at least two speeds forward and one in reverse. A water tank should be provided and both rollers fitted with an attachment for wetting.

The roller should be equipped with pneumatic-tired wheels for trailing and provided with suitable raising and lower-

Equipment Rental

(Continued from preceding page)

Maintenance of State highways should be performed with State personnel and equipment. Work of considerable consequence where the quantities involved are readily determinable and other conditions are favorable may frequently be let to contract.

The State should own all equipment that is extensively used or special units that are particularly designed for highway maintenance. Seasonal equipment should be rented from privately owned sources during the required period.

Administration of State-owned equipment should be handled by a separate department under an equipment engineer who is directly subordinate to the chief engineer or commissioner.

All mobile equipment and certain other units of a pre-determined minimum value should be placed on a rental basis. Rental rates should be established from actual records of the costs and experience as to usable life for the particular type of equipment involved.

Depreciation is generally calculated by the "Straight Line" method based on the estimated trade-in value of the equipment, and applied throughout the entire service life of the unit.

Rental rates established for each class of equipment should be sufficient to cover all costs except operator. The most generally favored method of assessment is on an hourly basis.

ing mechanism. Also a trailer tongue for trailing should be included.

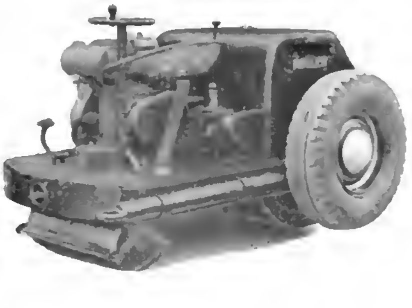

FIGURE 38

The roller should weigh at least 5,000 pounds without operator or added water in the rollers.

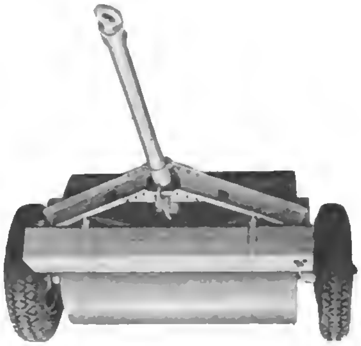

FIGURE 39

The tow type roller should have a single drum 48 inches or 60 inches in width. The drum should be of hollow semi-steel casting with a full length hub so constructed that it will hold water, sand, dirt or any other ballast material. Ballast filler openings and plugs should be provided in the ends of the roller drum. The roller should be equipped with a water tank and fitted with a device for wetting the roller. Check valves to prevent emptying tank when in trailer position should be provided.

The roller construction should include permanently attached pneumatic-tired wheels for trailing which become operative when the unit is in trailer position. The roller should weigh not less than 100 pounds per lineal inch of drum width without ballast.

The tandem roller should be powered with a gasoline engine of at least four cylinders and should have a transmission with two or more speeds in each direction. A water tank should be provided and both roller drums fitted with an attachment for wetting. Suitable brakes should be provided capable of holding the roller on grades without the gears being engaged. The tandem roller most generally used for highway maintenance operations will weigh from 5 to 10 tons.

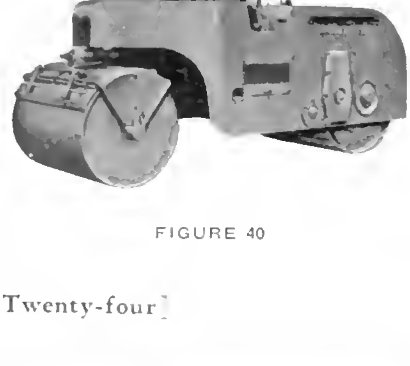

FIGURE 40

Shovels

The one-half cubic yard shovel is definitely the preference of all reporting agencies. The crawler type with trailer is more popular than the truck mounted type. The crawler type possesses a tractive advantage which evidently outweighs the lack of portability. Some agencies are still operating units of three-eighths cubic yard capacity, but there is little economic justification for such practice.

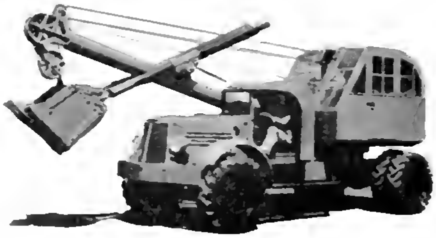

FIGURE 41

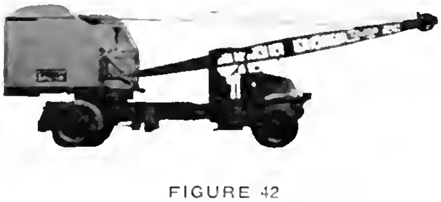

FIGURE 42

The truck mounted shovel should be the full revolving type. The revolving frame rollers should be readily replaceable without the necessity of raising the revolving frame from the rotating base. The capacity of the dipper should be struck measurement. The sizes most generally used on highway maintenance work are the $\frac{3}{8}$ or $\frac{1}{2}$ cubic yard capacity. The dipper should be constructed with tooth bases that will permit the use of detachable points. The boom should be self-locking type, power operated. Provision should be made for taking up wear at the points where the dipper stick or sticks pass through the saddle blocks.

The shovel unit should be mounted on a pneumatic-tired truck chassis powered with at least a six-cylinder gasoline engine. A separate power unit is not necessarily required for the $\frac{3}{8}$ cubic yard shovel. The $\frac{3}{8}$ cubic yard outfit should weigh not less than 18,500 pounds complete, as against 27,000 pounds for the $\frac{1}{2}$ cubic yard unit.

A dragline boom with a clamshell and dragline bucket should be provided.

FIGURE 43

The crawler shovel should be the full revolving type powered with an industrial type gasoline or diesel engine. The revolving frame rollers should be readily replaceable without the necessity of raising the revolving frame from the rotating base. The $\frac{1}{2}$ cubic yard capacity truck measurement is the most popular sized used on highway maintenance work. The dipper should be constructed with tooth bases that will permit the use of detachable points. The boom should be self-locking type power operated. Provision should be made to take up wear at the points where the dipper sticks pass through the saddle blocks.

The steering controls should be located at the operator's position in the cab and the machine should be steerable with the boom in any position with relation to the tracks. Brakes should be provided to hold the shovel both during travel or operation on any grade usually encountered on highway work. They should be designed so that full braking effect can be secured from the operator's position in the cab.

The shovel should not weigh less than 25,000 pounds nor more than 30,000 pounds. A dragline boom with a clamshell and dragline bucket should be provided. A skeleton or platform type trailer equipped with pneumatic tires should be provided for transporting the shovel. The crawler shoes should be flat without grousers.

Spreaders—Sand, Chip or Stone

The two-wheel roll feed hopper type spreader, 10 feet or 12 feet in length, is highly favored, particularly for the maintenance and construction of thin oil top, retread and nonskid type surfaces.

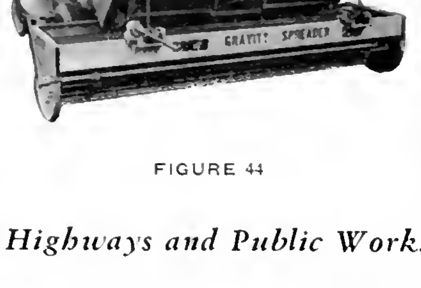

FIGURE 44

Second in choice is the tail gate gravity spreader generally used where it is desirable to operate the vehicle in reverse to apply material in advance of the wheels.

The revolving disc type spreader, while not rated as highly as the other two for spreading aggregate, is definitely the more popular unit for sanding operations on snow and ice removal. It is also suitable for spreading chlorides.

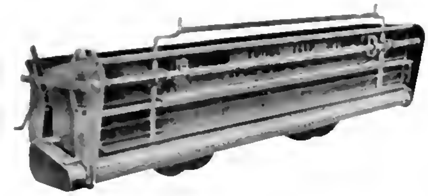

FIGURE 45

FIGURE 46

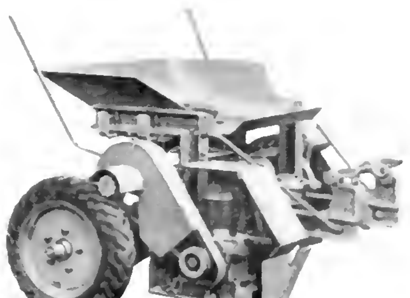

FIGURE 47

The gravity type spreader box (Figure 44) should be designed to permit quick attachment and to operate entirely suspended from the transporting vehicle. The box should be so constructed as to permit blanking off at least 50% of the effective opening and the rate of spread should be controlled by decreasing the width of the discharge opening. The spreader should not weigh less than 300 pounds.

The force feed spreader box (Figure 45) should be the hopper type mounted on pneumatic tires with a driving mechanism from the wheels to control the feed roll and agitator. It should be of sufficient size to permit spreading of aggregate up to 2½ inches in size and should weigh not less than 1,500 pounds.

The rotating disc spreader (Figure 46) is operated entirely suspended from the rear of the transporting vehicle. The material distributing disc is rotated by means of a small air-cooled gasoline engine. The spreader should weigh not less than 300 pounds.

The rotating disc type spreader (Figure 47) is also powered with a small air-cooled gasoline engine. It differs, however, from the spreader illustrated in Figure 72 in that it is mounted on pneumatic-tired wheels and is towed behind the transporting vehicle. This type spreader should weigh not less than 900 pounds.

Sweepers

The front-end tractor mounted rotary broom is the most extensively employed type of sweeper reported. The reason for this evidently is the compactness of the unit which permits turning within a short radius, thus minimizing interference with traffic. The attachment is easily removed, freeing the tractor for other operations. The greatest use of this unit is in connection with seal coat application.

The four-wheel trailer mounted power-driven broom is a close second choice for all sweeping requirements.

The four-wheel trailer mounted traction-driven broom is apparently less popular than the power-driven types.

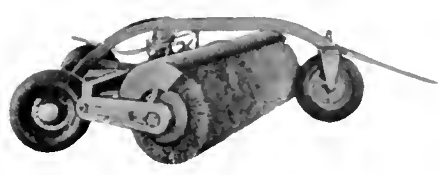

FIGURE 48

The broom used in rotary sweepers should be the refillable type and shielded with a full length metal hood. The broom should be driven by means of roller chains and sprockets. Construction should be such that the broom can be raised from the roadbed and disengaged while not in use for sweeping and also adjustable for variable sweeping pressures. It should be reversible type capable of sweeping either to the right or left.

The three different types of mountings are as follows:

The traction driven broom, tow type (Figure 48), should be mounted on not less than three pneumatic-tired wheels with transmission drive of not less than two speeds, preferably three.

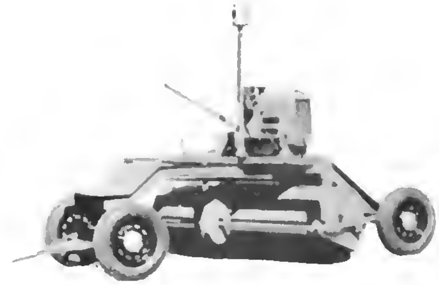

FIGURE 49

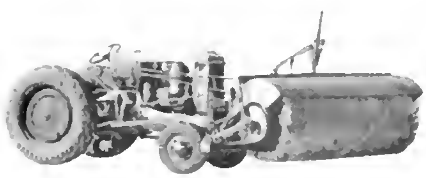

FIGURE 50

The power driven broom, tow type (Figure 49) should be mounted on four pneumatic-tired wheels and driven with an industrial type gassoline engine.

The wheel tractor attachment type sweeper (Figure 50), is driven by means of a power take-off and universal joint.

Tanks—Oil Storage

Oil supply tanks covered a wide range of capacities. General practice indicates little preference as to type of mount for the group between 800-gallon and 1200-gallon capacity. There is a definite trend toward truck mounting of tanks ranging from 1200-gallon to 2000-gallon capacity.

The 10,000-gallon to 14,000-gallon capacity oil storage tanks are not generally used, due perhaps to the ease of securing material deliveries as needed. Present transportation difficulties will no doubt encourage a return to the early practice of road oil and asphalt storage.

Tanks—Water

The 700 to 1000-gallon capacity truck mounted tanks with sprinklers are not extensively used, but are preferred to the trailer mounted tank of the same capacity. The truck mounted unit of approximately 1000-gallon capacity is the most popular size for tree watering.

Tractors, Tow Graders

The reporting agencies generally favor the 25 H.P. to 50 H.P. track-laying type tractor towing an eight to 12-foot blade grader for the maintenance of earth, gravel and crushed rock surfaces. The unit is also adaptable to maintenance of oiled surfaces as well as shoulder and roadside blading. The size and capacity of the unit are governed by local conditions.

A tractor of approximately 40 H.P. with 10-foot blade grader meets the demands of routine maintenance. Tractors up to 70 H.P. with 12 to 14-foot blades were accorded second choice for maintenance of earth roads, possibly due to their adaptability to construction work when not required as maintenance units.

Wheel type tractors of 25 to 50 H.P. towing an eight to 12-foot blade grader have also proven satisfactory for traveled way maintenance on both treated and untreated surfaces. This particular combination is more adaptable to light work where tractive conditions are favorable. The wheel type tractor is particularly suited to the operation of various attachments such as the front-end loader, hoists, tractor driven rotary sweeper and mowers.

The track-laying type tractors of 40 to 95 H.P. are very popular. The larger sizes equipped with angle or bulldozers are most efficient in slide removal and grading work, especially where traction is poor. They also perform exceptionally well in combination with loading attachments. The 40 H.P. unit is the most widely used on highway maintenance work.

Drawbar H.P.: Maximum not less than—	25	35	44	54	69	95
Weight: Not less than, lbs.—						
Diesel	6,000	9,000	12,500	16,000	20,000	27,800
Gasoline	6,000	9,000		11,000		

The tracklaying type tractor should be powered with either a gasoline or diesel engine and equipped with a suitable starter.

The tractor should be provided with a take-off suitable for operating mechanical or hydraulic units. A canopy top and side curtains should be provided.

Drawbar H.P.: Maximum not less than	15	30	40	45
Weight: Not less than, lbs.	2,500*	3,800*	4,700*	6,200*
Recommended working weight, lbs.	2,500	5,800	8,000	10,500

* Not applicable for 1400 minimum weight graders.

The wheel type tractor should be powered with either a gasoline or diesel engine and equipped with a suitable starter and provision for power take-off, either front, side or rear as desired.

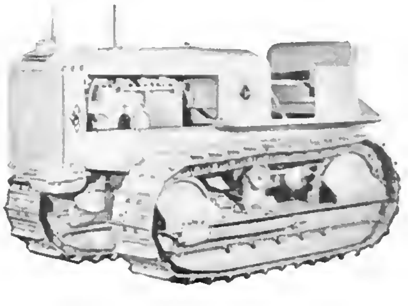

FIGURE 51

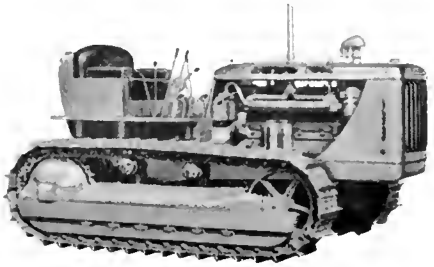

FIGURE 52

FIGURE 53

The transmission should have at least four speeds forward with a high gear speed of not less than 10 miles per hour, and a low gear speed of not less than 2.25 miles per hour, both at recommended governed speed of motor. Suitable service and parking brakes should be provided.

Trucks

The one-half to three-fourths ton express body, while very popular for shoulder, roadside and traveled way maintenance in the Pacific States, is not so extensively used in the remaining areas where the one and one-half to two-ton capacity dump truck apparently meets general demands.

The one and one-half to two-ton capacity dump truck is the most widely used truck on highway maintenance. The unit is consistently favored on all types of maintenance, other than bridges, even for hauling material. It is likewise used in towing light blade graders, drags, road maintainers, mowing machines, propelling the light duty straight blade snow plow, sanding icy pavements and all related work.

The one and one-half to two-ton capacity flat bed is widely used in the maintenance of safety devices, since special racks or compartments can be constructed readily.

In certain localities a limited number of three to six-ton dump trucks have been found desirable either because such units are required for snow removal operations, or they can not be rented readily from outside sources as needed for slide removal, grading and large scale hauling. Apparently their necessity and advantages for specific operations outweigh their lack of adaptability to routine maintenance.

On snow removal work the four-wheel drive truck, two to five-ton capacity, with dump body is greatly favored over the two-wheel drive of similar capacities. They are also suitable for towing grading units and the transportation of maintenance materials. Where snow removal is of no consequence the two-wheel drive trucks will meet all requirements.

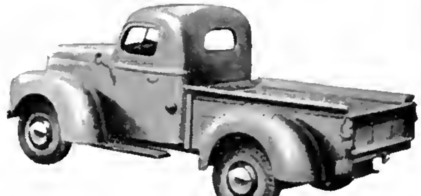

FIGURE 54

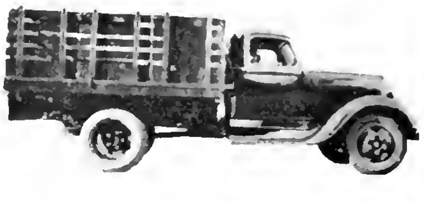

FIGURE 55

The ½ and ¾ ton capacity express body truck should have a chassis weight of not less than 2,000 pounds and 2,400 pounds espectively and should have at least a 75 H.P. six-cylinder gasoline engine. The :ab should be steel enclosed with safety glass.

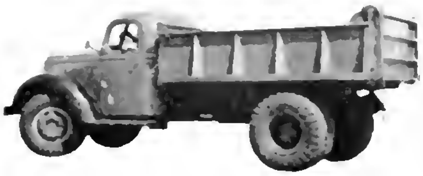

FIGURE 56

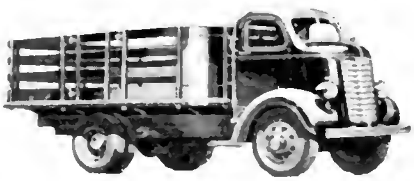

FIGURE 57

FIGURE 58

ize, Tons	1½–2	2–2½	2½–3	5–6
apacity: Manufacturers gross load rating not less than, pounds	13,000	14,000	18,000	23,000
Veight, Chassis: Not less than, pounds	4,100	4,250	6,000	7,100
Vheelbase: Approximate Inches	160	160	170	160
ngine: Gasoline at least six-cylinder and not less than, H P	70	70	88	90

Geographical Effect

Contrary to general expectations, eographical locations exhibit little nfluence on the general trends of quipment usage. The few instances vhere this occurred and the parieular units affected are enumerted herewith:

The light one-half to three-fourths on capacity express body truck is ised as a patrol unit in the Pacific nd Mountain group of States. This articular unit was not recommended lsewhere. The one and one-half to wo-ton capacity dump truck is faored by the remaining reporting geneies.

The portable two-blade maintainer is most commonly used on maintenance of untreated crushed rock or gravel surfacing. Its use is confined mainly to the Central States having a considerable mileage of untreated rock or gravel surfacing.

Small portable bituminous mixers are favored in all but the Pacific and Mountain States. This might indicate that in the latter two areas patch material is either blade mixed or purchased from commercial sources.

Discs and harrows were recommended by the Pacific Group of States for use in oil treatment work. This equipment is apparently not used in other areas.

Large dump trucks are recommended only by the Pacific and and Mountain States. The one and one-half to two-ton capacity dump truck is more popular in all other areas. This use of heavy trucks may be due, in part, to the necessity of utilizing the heavy trucks when not required for snow removal work.

For loading operations the Pacific and Mountain States prefer the power shovel rather than the mechanical loaders used in the other localities.

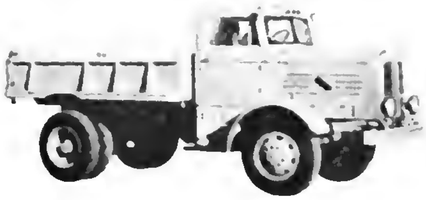

FIGURE 59

FIGURE 60

Size: Tons	2½–3	3–4	6
Capacity: Manufacturers gross load rate not less than	14,000	18,000	23,000
Weight, Chassis: Not less than pounds	4,200	7,300	8,000
Engine: Gasoline, under hood, should have at least six cylinders developing not less than, H P	85	95	110

Control of Roadside Vegetation to Reduce Fire Hazards

(Continued from page)

This kind of burning, without the drying effect of diesel oil, progresses slowly. It can be devastatingly swift in action, however, in dry vegetation and must be done with care. Then there is always the possibility of using soil sterilizing and growth killing chemicals to produce a firebreak. So far, materials available for such work are either based on arsenical compounds, which cannot be used by highway forces on the State right of way because of danger to livestock, or are chlorate compounds that cause too great a fire hazard either when sprayed on growth or inadvertently on operator's clothing. Other types are too costly to use in a large operation involving over 1,000 miles of roadside.

Under general conditions in California diesel oil is the most satisfactory material that has been found for use in control of roadside vegetation. It is economical in first cost and application. In areas where livestock raising is a predominant industry, there is no possibility of poisoning stock which travels along the highway or is pastured on adjoining lands. During its application, no undue hazard to operators or equipment develops because of a high degree of inflammability.

It is felt that a greater degree of cooperation between the property owners or operators and the Division of Highways is much to be desired.

TRUCKS GENERAL:

All trucks up to 3 ton capacity should have at least four speeds forward, the trucks above 3 ton capacity should have not less than five. Helper springs should be provided on the rear and vacuum booster or compressed air type brakes should be provided on all four wheels. The wheels should be steel, dual on rear with balloon tires. The cab should be steel enclosed with safety glass.

The dump body on trucks should not exceed 120 inches in length by 72 inches in width. The body should be square cornered with straight sides which are reinforced with gusset type braces attached to the running board which should extend the full length of the body. The top of the sides should be reinforced and provisions made for extending the height with wooden sideboards. The dumping mechanism should be hydraulically operated with controls located in the cab.

Bids and Awards of Highway Contracts for April and May

ALAMEDA COUNTY—On Atlantic Avenue in the city of Alameda, between Main Street and Webster Street, about 0.8 mile to be graded and paved with asphalt concrete on crusher run base. District IV. Louis Biasotti & Son, Stockton, $96,678; Stolte, Inc., Alameda, $101,622; Lee J. Immel, Berkeley, $104,229; Chas. L. Harney, San Francisco, $113,893; Guerin Bros., South San Francisco, $135,307. Contract awarded to Heafey-Moore Co., Oakland, $96,414.

IMPERIAL COUNTY—Between El Centro and Brawley, about 11.8 miles to be surfaced with plant-mixed surfacing. District XI, Route 26, Section F, Imp., G. R. E. Hazard & Sons Contracting Co., San Diego, $80,800; Southwest Paving Co., Roscoe, $82,940; Daley Corp., San Diego, $86,585; Griffith Co., Los Angeles, $86,740; Oswald Bros., Los Angeles, $88,420; Pacific Rock & Gravel Co., Los Angeles, $107,600. Contract awarded to Basich Bros., Torrance, $73,520.

INYO AND MONO COUNTIES—Between Laws Bridge and one mile south of Benton Station, portions about 11.1 miles to be repaired by constructing road-mixed surfacing over the existing bituminous surfacing. District IX, Route 76, Sections A, AB. M. E. Whitney, Bakersfield, $44,618; Basich Bros., Torrance, $45,441; A. S. Vinnell Co., Alhambra, $47,136; Owl Truck & Construction Co., Compton, $50,236; Oswald Bros., Los Angeles, $50,945; Sierra Trucking Co., Inc., Reno, Nev., $51,281; Bonadiman McCain, Inc., Los Angeles, $58,161; Claude C. Wood, Lodi, $63,991. Contract awarded to Phoenix Construction Co., Bakersfield, $43,172.

KINGS COUNTY — Between Lemoore Flying School and the junction with Houston Avenue, 1.5 miles west of Lemoore, about 10.8 miles to be graded and surfaced with plant-mixed surfacing. District VI, Route 10, Section B. Calowell Construction Co., Long Beach, $278,654; N. M. Ball Sons, Berkeley, $282,121; A. J. Raisch, San Jose, $282,483; Phoenix Construction Co., Bakersfield, $300,326; Pacific Rock & Gravel Co. & M. W. Stanfield Co., Los Angeles, $306,164; J. E. Haddock, Ltd., Pasadena, $316,157; Guerin Bros., South San Francisco, $331,025. Contract awarded to Piazza & Huntley, San Jose, $270,974.

MARIN AND SONOMA COUNTIES—About 4 miles east of Ignacio Junction, the northerly timber trestle approach spans of the bridge across Petaluma Creek to be reconstructed with concrete floor on steel stringers. District IV, Route 8, Sections A, A. James B. Allen, San Carlos $77,377; Fred J. Maurer & Son, San Francisco, $86,752; Dan Caputo, San Jose, $91,902; Engineers, Ltd., San Francisco, $93,475; Underground Construction Co., Oakland, $94,237; Kiss Crane Co., El Cerrito, $94,970; Bent Construction Co., Los Angeles, $99,365; Lee J. Immel, Berkeley, $100,330; Fredrickson & Watson Construction Co., Fredrickson Bros., Oakland, $105,197; Trewhitt-Shields & Fisher, Fresno, $107,464; Fred D. Kyle, Los Angeles, $109,742; Ralph A. Bell, San Marina, $110,791; M. B. McGowan, Inc., San Francisco, $113,429; Harry J. Oser & Peter Sorenson, Redwood City, $138,406. Contract awarded to A. Soda & Son, Oakland, $65,909.

MENDOCINO COUNTY—Between Hopland and Crawford Ranch, about 6.7 miles, armor coat to be constructed. District I, Route 1, Section B, Clements & Co., Hayward, $43,130; Granite Construction Co., Watsonville, $47,892; Harold Smith, St. Helena, $49,480; Close Building Supply, Hayward, $49,855; N. M. Ball Sons, Berkeley, $52,700. Contract awarded to E. A. Forde, San Anselmo, $41,465.

MENDOCINO AND HUMBOLDT COUNTIES—Between McCoy Creek and Benbow at various locations, furnishing and stockpiling screenings. District I, Route 1, Sections K, A. Harold Smith, St. Helena, $13,982; Mercer, Fraser Co., Eureka, $14,500. Contract awarded to Tom Hull, Eureka, $12,250.

MENDOCINO COUNTY—Between Old Sherwood Road and Rattlesnake Creek crossing No. 3, portions only, a net length of about 4.4 miles, armor coat to be constructed. District I, Route 1, Sections G, H, I. Pacific Truck Service, Inc., San Jose, $20,854; E. A. Forde, San Anselmo, $25,882; California Paving Co., San Mateo, $29,966. Contract awarded to Close Building Supply, Hayward, $18,894.

NEVADA AND SIERRA COUNTIES—Portions between Truckee and Nevada State line, about 5.6 miles, plant-mixed surfacing to be placed. District III, Route 38, Sections A, B, A. Claude C. Wood, Lodi, $52,665; A. Teichert & Co., Sacramento, $53,389. Contract awarded to Hemstreet & Bell, Marysville, $40,000.

PLACER COUNTY — Between Baxters and Airport, about 3.0 miles, plant-mixed surfacing to be placed. District III, Route 37, Sections D, E. Claude C. Wood, Lodi, $26,480; A. Teichert & Co., Sacramento, $26,564; McGillivray Construction Co., Sacramento, $27,028; Clements & Co., Hayward, $28,200. Contract awarded to Hemstreet & Bell, Marysville, $25,780.

PLUMAS, LASSEN, SIERRA COUNTIES—Between Ede's Ranch and State line, portions about 15.8 miles in length to be repaired by construction of plant-mixed surfacing over the existing bituminous surface. District II, Routes 21, 29, Sections G, A, E, A. A. Teichert & Company, Sacramento, $88,960; Parish Bros., Sacramento, $91,878; A. J. Raisch, San Jose, $99,950; Hemstreet & Bell, Marysville, $106,640; Southwest Paving Co., Roscoe, $120,100; Claude C. Wood and Frank B. Marks & Sons, Lodi, $120,920; M. J. Ruddy & Son, Modesto, $137,486. Contract awarded to Isbell Construction Co., Reno, $84,065.

SAN DIEGO COUNTY—Between Route 2 and Route 77, about 7.5 miles to be graded and surfaced with road-mixed surfacing. District XI, Miramar Road. Bressi & Bevanda Constructors, Inc., Los Angeles, $118,524; Basich Bros., Torrance, $123,351; V. R. Dennis Construction Co., San Diego, $153,418; Oswald Bros., Los Angeles, $160,187; George Herz & Co., San Bernardino, $167,830; Daley Corp., San Diego, $193,333; B. G. Carroll, San Diego, $193,816; R. E. Hazard & Sons Contracting Co., San Diego, $199,089; Griffith Co., Los Angeles, $221,063. Contract awarded to Calowell Construction Co., Long Beach $111,711.

SAN MATEO COUNTY—At Finney Creek, a portland cement concrete arch culvert to be constructed and about 0.4 mile to be graded and bituminous surface treatment applied. District IV, Route 56, Section A. M. E. Whitney, Bakersfield, $20,370; Peter Sorenson, Redwood City, $20,819; Frank George, Sacramento, $21,540; Louis Biasotti & Son, $24,692; Harms Bros., Sacramento, $26,018; Dan Caputo, San Jose, $27,153; F. Fredenburg, South San Francisco, $29,997. Contract awarded to California Paving Co., San Mateo, $20,105.

SAN MATEO COUNTY—San Bruno Avenue at Bayshore Highway intersection, a reinforced concrete bridge to be constructed and road connection and widenings to be graded and surfaced with plant-mixed surfacing on crusher run base. District IV, San Bruno. Guerin Bros., South San Francisco, $15,752; James B. Allen, San Carlos, $15,228; S. J. Amoroso Construction Co., San Francisco, $16,160; Dan Caputo, San Jose, $17,618; N. M. Ball Sons, Berkeley, $22,126. Contract awarded to Wm. E. Thomas Concrete Construction, Sacramento, $14,069.

SANTA BARBARA COUNTY—Between Cebada Canyon and Reservation Boundary, about 3.3 miles to be graded and surfaced with plant-mixed surfacing. District V, Lompoc Cutoff. M. W. Stanfield Company, Los Angeles, $172,482; Fredrickson & Watson Construction Co., Fredrickson Bros., Oakland, $173,023; Basich Bros., Torrance, $173,025; Brown, Doko & Baun, Pismo Beach, $185,939; J. E. Haddock, Ltd., Pasadena, $217,767. Contract awarded to Calowell Construction Co., Long Beach, $153,360.

SHASTA COUNTY — Portions between Redding and Bass Hill, about 8.5 miles to be surfaced with plant-mixed surfacing. District II, Route 3, Section B. A. Teichert & Co., Sacramento, $43,430. Contract awarded to M. J. Ruddy & Son, Modesto, $39,562.

SHASTA COUNTY—Between ½ mile south of Clear Creek and Redding Subway, about four miles to be graded and surfaced with plant-mixed surfacing over cement treated base. District II, Route 3, Section A. Elmer J. Warner, Stockton $210,851; M. W. Stanfield Co., Los Angeles, $214,739; M. J. Ruddy & Son, Modesto, $219,787; Hemstreet & Bell, Marysville, $223,893; Marshall S. Hanrahan, Redwood City, $228,027; A. J. Raisch, San Jose, $239,953; Contract awarded to A. Teichert & Co., Sacramento, $208,971.

SOLANO COUNTY—Between Route 74 near Flosden and Route 7 near junction with Blue Rock Springs Road, about 3.1 miles to be graded and surfaced with plant-mixed surfacing on crusher run base. District X, Route 208, 7, Sections B, G. Fredrickson & Watson Construction Co., Fredrickson Bros., Oakland, $172,128; Louis Biasotti & Son, Stockton, $178,848; Bressi & Bevanda Constructors, Inc., Los Angeles, $179,227; Guerin Bros., South San Francisco, $184,650; Lee J. Immel, Berkeley, $198,570; Chas. L. Harney, San Francisco, $284,887. Contract awarded to Heafey-Moore Co., Oakland, $163,219.

TRINITY COUNTY — Between Helena and Weaverville, about 14.5 miles to be resurfaced with plant-mixed surfacing. District II, Route 20, Section F. Contract awarded to Clements & Co., Hayward, $35,960.

VENTURA COUNTY—On various roads and streets in the vicinity of Hueneme, about 9.1 miles to be graded, untreated rock base to be constructed, and plant-mixed surfacing to be placed over existing pavement and newly constructed untreated rock base. District VII, Griffith Co., Los Angeles, $197,796; M. W. Stanfield, Los Angeles, $197,812; Bressi & Bevanda Constructors, Inc., Los Angeles, $198,717; Vido Kovacevich, South Gate, $202,671; Guerin Bros., South San Francisco, $227,484; Oswald Bros., Los Angeles, $233,596; J. E. Haddock, Ltd., Pasadena, $235,815. Contract awarded to Basich Bros., Torrance, $175,260.

YOLO COUNTY — Between Irrigation Canal and Reclamation Ditch, portions about 2.4 miles, plant-mixed surfacing to be constructed. District III, Route 99, Section B. A. Teichert & Co., Sacramento, $16,445. Contract awarded to McGillivray Construction Co., Sacramento, $16,128.

A man could save twenty years of his life by studying the experience of others.

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Department of Public Works
Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

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A. H. HENDERSON, Assistant Director

MORGAN KEATON, Deputy Director

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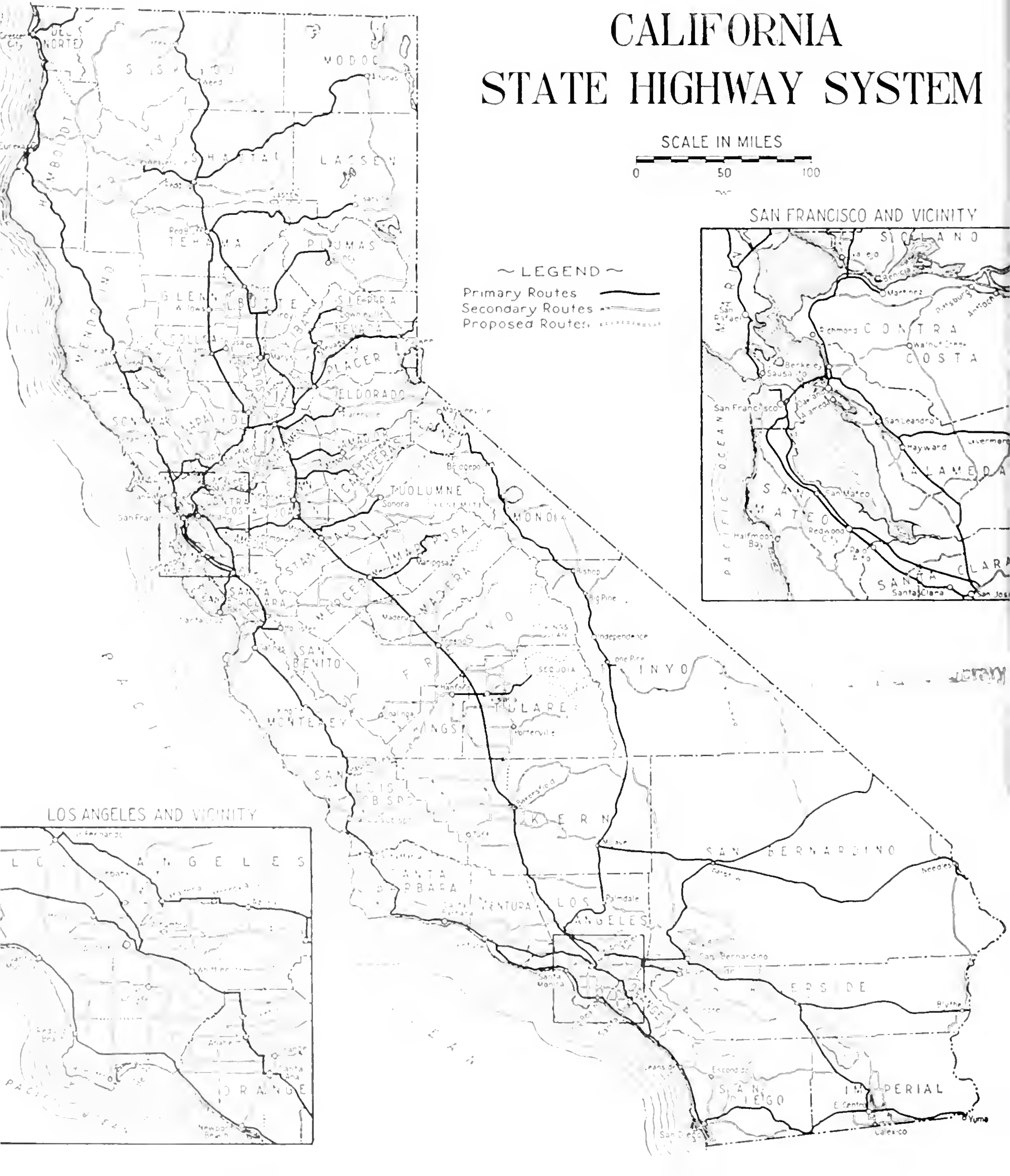

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[illegible] Nos. 7, 8

California Highway System Meeting Extraordinary Demands in Volume and Tonnage of Wartime Truck Traffic

CALIFORNIA'S highways are playing a major part in the war effort. Coincidently, the war is exacting a heavy toll from the State Highway System due to the ever-increasing heavy traffic generated by truck movements.

Road surfaces constructed to bear normal traffic have taken such excessive pounding in certain localities serving defense plants, shipyards and military and naval installations that the Division of Highways has had to expend in maintenance and repair alone since Pearl Harbor approximately $15,000,000.

Secondary rural routes in California known as feeder roads and which are the State's farm-to-market arteries have assumed great importance in the prosecution of the war.

PERSHING FORESAW IT

General Pershing once said: "The country road will be of tremendous value in time of war. The roads must be relied upon to obtain needed food supplies."

This prediction is fully borne out by records of truck haulage of food products in California to which must be added the huge movements of materiels for the Army and Navy.

Problems confronting the Division of Highways necessitate a determination of the part played by rubber-borne highway transportation in the present emergency and the contribution of highways to the war, with particular emphasis on California.

In many ways conditions in California differ from those prevailing in the majority of States. California, with an area of 159,000 square miles, is second in size only to Texas. Its population of 7,000,000 amounts to only 44 per square mile, as compared with 281 per square mile in New York; 220 in Pennsylvania; 141 in Illinois; 168 in Ohio; and 546 in Massachusetts.

Similarly, California with a total road mileage slightly in excess of 100,000 miles has only 0.6 of a mile of roads to square mile of area; while the other States referred to above all have from 3 to 3½ times that road density: New York being 1.9 miles of road to the square mile; Pennsylvania 2.0; Illinois 1.9; Ohio 2.0; and Massachusetts 2.1 miles per square mile.

TWO IMPORTANT FACTORS

These two factors mean that in California, with its more sparsely populated area and lesser road density, much of the highway traffic must travel considerably greater distances to and from destinations.

Another factor peculiar to California is the concentration of so large a percentage of population in three urban areas. Of the 7,000,000 people in this State, 5,000,000 (72%) live in urban communities and of this 5,000,000, 4,100,000 (82% of urban and 60% of total) are concentrated in the San Francisco, Los Angeles and San Diego metropolitan areas.

These three areas, where live 60 per cent of the State's total population, are all far from the interior portions of the State and far from each other. This situation means that these large centers are most dependent upon truck transportation, not only for food products, but industrially, for raw materials processed or fabricated in the plants situated there.

DEPENDENT ON ROADS

While American railroads are the backbone of long haul transportation, at the present their facilities are taxed to capacity in both lines and yards. The nation is, therefore, more dependent than ever upon highways for a large share of commercial transportation. Just how dependent California is on the truck medium of freight distribution may be made more impressive by presentation of a few figures.

In the matter of intra-State freight movement, that is freight whose origin and destination both lie within the borders of California, and which is transported by public carriers for tariff, the California Railroad Commission has assembled some most significant data. Of the total freight tariff of $157,000,000, paid during 1941 for this class, $105,000,000 or 66.8 per cent was paid for truck haul; steam railroads were second with 27.5 per cent ($43,200,000); express carriers third with 3 per cent ($1,740,000); electric railroads fourth at 1.4 per cent; and water-borne carriers last with 1.3 per cent. The 1940 figures for this same breakdown paralleled those of 1941 with 65.3 per cent for truck traffic and 28.5 per cent for railroads.

TRUCKS FREE TANK CARS

To repeat, these figures include only intra-State freight for which tariff was paid and do not include the probably greater volumes hauled on State roads and highways in trucks owned by the producer or manufacturer. These latter include not only such commodities as agricultural produce and livestock which invariably are transported some part of their travel by truck, but lumber and mineral products as well, particularly petroleum, which, under a recent directive by the Office of Defense Transportation designed to free tank cars, can not be transported by rail for a distance of less than 200 miles.

A specific instance of the tremendous amount of trucking which California highways are called upon to carry is that of the five billion pounds of market milk which are annually transported on rubber and most of which goes to the three metropolitan areas.

4[illegible],000,000 TONS OF PETROLEUM

The State Department of Agriculture estimates that California produces approximately 20 million tons of farm and ranch crops annually. The larger items of mineral products produced in this State in 1940 were estimated by the Bureau of Mines to total over 72 million tons. The largest

Intra-state freight tariffs paid to public carriers in 1941 totaled $157,000,000 of which 66.8 per cent was hauled by trucks

single mineral item, petroleum, accounted for nearly 45 million tons of this total. Miscellaneous stone, including aggregates, which, because of its low unit value, was almost entirely transported by truck, accounted for more than 23 million tons.

A large part of the trucking required to transport these materials is of direct necessity to the prosecution of the war.

As the trucking and automobile travel can not be accomplished without adequate road surfaces, it follows that the highways over which the trucks must travel are just as essential.

HIGHWAYS TAKE PUNISHMENT

On the basis of data accumulated by the Traffic Department of the Division of Highways, there are generated annually on the rural State Highway System of California approximately 1,267,000,000 vehicle miles of truck travel. The impact of this volume of trucking spells destruction to highway surfaces not given proper maintenance and periodic reconstruction.

Studies have shown that the determining factor in road deterioration is the continued repetition of impact from the axle loads of heavy trucking.

It has been noted during the past year that roads, which had carried traffic satisfactorily for a number of years and had been kept in good condition by normal maintenance, disintegrated rapidly when subjected to the unusual load repetitions of the heavy hauling in connection with military construction. This factor is one of sudden redistribution of traffic on State, county and city roads and streets in the vicinity of military and industrial establishments and on roads feeding to materiel sources. In many instances, roads basically designed for low traffic volumes are called upon to bear the repeated impacts of high volumes of heavy traffic.

The increase in truck traffic is indicated through reports of the Board of Equalization on receipts of their revenue from the operations tax on the gross income of trucking operators in California. These data show an increase in tax revenue of 33 per cent for 1941 over 1940 and an additional increase of 32 per cent for 1942 over 1941 with no increase in gross income operation tax rates.

The increase in tax revenues based on gross receipts of for-hire carriers may have been due, in part, to increased tariff rates and to higher load factors for these carriers.

This increase in a period of two years was accomplished without a very large increase in the number of truck units. Similarly bus line revenues have increased 300 per cent during the same period. In other words, the trucks and busses are carrying more and heavier loads with practically the same equipment and the destruction of road surfaces is accelerated by the multiplication of impacts from the increased number of heavier axle loads.

RUBBER-BORNE TRAFFIC

A few specific examples indicate the volumes of rubber-borne traffic. The Kaiser Ship Building Yards in the San Francisco Bay Area report that 50 per cent of their freight is received by truck and 85 per cent of their employees travel to and from work by automobile. A survey of the Emeryville industrial district also revealed that 50 per cent of the freight received and shipped is handled by truck and 90 per cent of the employees used cars for transportation. The Pacific Gas and Electric Company reports 40 per cent of their freight is received by truck and 99 per cent of their employees travel on rubber. In the livestock industry 75 per cent of shipments are made by truck. In 1941 the abattoirs in Stockton and South San Francisco shipped the equivalent of 67,000 carloads by truck.

Truck traffic on the State Highway System in 1942 was consistently above the level of 1939 and the maintenance of this high level is considered remarkable considering the restrictions placed on trucking. To some extent, this may be attributed to the fact that there are large areas of the State devoid of railroad communication and other areas where railroad facilities are not sufficient for wartime needs. At border quarantine stations, which are all remote from centers of production, truck traffic entering the State in 1941 was 11.3 per cent in excess of that for 1940. The comparable ratio for 1940 and 1942 was 12.4 per cent.

There is a rational explanation for truck traffic holding up as it has. Practically all goods moving either by rail or boat have a prior and subsequent movement by truck. There is an obvious increase in the goods being produced despite lessening production for civilian consumption. California is in the theater of war and there are great movements of commodities for purely military purposes.

RAPID AND EFFICIENT

Truck movements over long distances are virtually all made by "for hire" carriers, who generally speaking utilize truck and trailer combinations in their work. There were 47,551 trucks and 13,286 trailers engaged in this work last year in California. Long distance movements are exceedingly rapid and efficient. The schedule from San Francisco Bay points to Seattle is about 30 hours. Approximately 75 per cent of this truck movement is now made on government bill of lading.

The truck schedule from Ogden, Utah, to San Francisco is less than 30 hours. The truck run from San Francisco to Los Angeles has been long established but now goods are also moved from such places as Benicia to Los Angeles and San Diego, the schedule to the latter point being approximately 17 hours. There are also a number of short hauls which are frequent, such as hauls from Sacramento, Stockton and Tracy to San Francisco Bay. Loads between such depots may range from an average of 75 trucks and trailers daily to a peak of 200.

It is estimated the total tonnage of agricultural products will approximate 20,815,000 tons in 1943 as compared with 21,160,000 tons last year. Not all of this tonnage leaves the farm, but some 15,000,000 tons move and an attempt is to be made this year to move a greater amount off the farms than heretofore.

It is estimated that approximately two-thirds of the State production is moved by truck. This truck movement does not include some 5,000,000 tons of commodities delivered from farm to railroad in the county of production.

Possibly as much as 60 per cent of the freight handled by common carrier truckers is for the military authorities and the weights of individual shipments have increased from an average of 350 pounds to approximately 2,000 pounds.

In 1942 a total of 137,000 carloads of livestock was moved of which the equivalent of 102,000 carloads was moved by truck.

FREIGHT FOR WAR NEEDS

A trucking company with a territory extending from Yuba City in the north to Tulare in the south serves large cannery plants in the central part of the State. About 85 per cent of all their business is in connection with hauling agricultural products from the field to these canneries. Their longest haul is 185 miles. During January and February 1943, they had a special contract for hauling for the Army and Navy, amounting to 5,641,874 pounds of agricultural products, an average haul of about 225 miles.

A large milk producing and processing company in central California has a total of about 1,300 truck trailers and semitrailers of its own, of which 205 are heavy and used in long hauling. One of their contract haulers transports from Smith River, a non-

Thousands of tons of cement are being hauled by truck in large metal tanks as shown above

Truck and trailer combinations are carrying some 45,000,000 tons of petroleum products, largely gasoline for war uses

railroad point, in Del Norte County, to San Francisco, nearly 400 miles. Another one hauls from Ferndale in Humboldt County to San Francisco, a distance of 285 miles.

TRUCK AND TRAILER HAULS

Most of these long hauls are carried in large trucks and trailers with a total load of from 18 to 20 tons. The company's own fleet has increased 100 per cent since 1940 due to war conditions. It estimates that in 1942, about 20 per cent of its sales was to the Army. It estimates this year will be much higher.

Before the war approximately 27 per cent of California's gasoline moved directly from the refineries over the highways. The initial movement of the remaining 73 per cent of the total was apparently by rail or boat to warehouses, from which it was distributed over the highways.

The original order of the Office of Price Administration prohibiting the use of rail tank cars in transportation of gasoline or other petroleum products for distances of less than 100 miles, resulted in placing the burden of this extra transportation on tank truck facilities. Furthermore this order recently was amended to prohibit use of tank cars for hauls of less than 200 miles. Tank car equipment has been withdrawn from California for use elsewhere to such an extent that the bulk of petroleum products consumed within the State are being handled by motor truck carriers. Since gasoline tax levies in January and February, 1943, respectively, were only 27 and 24 per cent below the corresponding months in 1942, it is clear that there has been little if any decrease in the hauling of gasoline by truck. It must be remembered that a great deal of gasoline is also hauled for Army use.

It is estimated 12,000,000 tons of agricultural products are being moved to canneries by truck and trailer

TRUCKS DO THE MOST

The 1943 business of a large cement company with a plant in the eastern part of central California was handled between rail and truck as follows: Total haul by rail during first quarter of 1943, 107,583 barrels; hauled by truck, 211,740 barrels. Nearly 100 per cent was for the war effort.

In the coastal area of northern California, eight companies, which have a yearly production of 2½ to 30 million board feet of lumber per year with a combined output of 50 million board feet, are now hauling this amount by truck over the highways about 250 miles to the San Francisco Bay region, 96 per cent of the haul going directly into the war effort.

In the same region, four companies are hauling by truck a total of 360,000 board feet of logs per day from the woods to their mill. The hauls range from ten to fifty miles. Additional miscellaneous lumber products from this area, amounting to 10 million board feet will be hauled by truck this year to the San Francisco Bay district. In the Sierras of central California, from three mills a total yearly production of 190 million board feet of lumber will be hauled over highways during 1943, continuing during the war.

HIGHWAY SERVICE TRIPLED

Nearly three times as much truck hauling is being done by the lumber industry now compared to before the war.

In the north coastal region, 1,000 tons of chrome and manganese ore is hauled by truck from mines a distance of 85 miles to a War Production Board stockpile.

15,000,000 TONS HAULED

It is estimated that the total tonnage of rock, sand, and gravel delivered in northern California in 1942 was conservatively 15,000,000 tons. This was about double the production in 1941 and 85 per cent of the total was utilized for military and naval work. Approximately 35 per cent of the total production was delivered by truck.

California dairy products move almost entirely by truck. Fresh milk, cream, butter, and cheese comprise the dairy products group with milk alone accounting for 93 per cent of the total tonnage. Based on 1942 production figures, approximately 6 billion pounds of milk fat will be transported over California highways during 1943.

Truck receipts of butter, cheese, eggs, and dressed poultry at San Francisco during 1942 in the order named were 22,988,674 pounds, 11,427,594 pounds, 1,286,038 cases, and 9,520,248 pounds.

VAST FOOD PRODUCTS

Truck receipts for the same commodities at Los Angeles were: butter, 26,100,820 pounds; cheese, 7,273,470 pounds; eggs, 1,138,224 cases; dressed poultry, 10,433,274 pounds.

A California Department of Agriculture report shows the volume of fruits, nuts and vegetables hauled by truck passing through border inspection stations during 1942 from states of origin expressed in packages and estimated carload equivalents as follows:

	Packages	Carloads Equivalent	Percentage
Alabama	190		
Arizona	1,158,733	2,373	14.84
California	4,942,854	10,125	63.30
Colorado	6,881	14	.09
Florida	103		
Georgia	792	2	.01
Idaho	115,520	236	1.48
Mexico	1,354	5	.02
Nevada	28,493	58	.36
New Mexico	63,770	130	.82
Oklahoma	1,645	4	.02
Oregon	534,553	1,095	6.85
Texas	74,725	153	.95
Utah	175,999	300	2.25
Washington	703,714	1,442	9.01
Totals	7,809,326	15,997*	100.00

* 384 estimated carloads of watermelons not included.

During 1942 117,634 cattle and calves were brought into the State by

(Continued on page 18)

Shipments of hay to Los Angeles in 1942 over State highways totaled 415,367 tons

Scene at intersection on East Shore Highway, Contra Costa County, where an electric monitor (in circle at left) governs through and turning movements on six lanes of heavy traffic watched by officer on bike shown in circle at right

45,000 Vehicles Per Day Controlled by East Shore Highway Crossing Signal

WITH the present development and perfection of traffic-actuated signals used in connection with highway channelization, the traffic officer at a busy intersection can sit on his bike and calmly watch traffic handle itself! And the traffic does handle itself—some turning right, some left, and still more going straight through—with all conflicting movements stopped without waving of arms and blowing of whistles.

The little "iron man," an electric installation located near the intersection does the job. All the driver has to do is stay in the proper traffic lane—right if he wants to turn right; left, which is marked, if he is turning left—and watch the signal.

When he crossed a certain spot on the pavement, a spot he did not see, the "iron man" made a note of him through one of his many "eyes" and in due course will give him a green light while he holds the other fellow with the red.

ALWAYS ON THE JOB

Twenty-four hours a day, three hundred and sixty-five days in the year, this procedure goes on at many heavily traveled intersections on California highways.

The engineers call it "channelization" and "traffic-actuated signals"—both of which it is.

Left-turn lanes, or "storage lanes," are provided by reducing the width of the traffic island or division strip, to permit an extra single lane in which vehicles can temporarily wait, out of the line of straight through traffic, until the controller, the "iron man," can get them through.

The right-turn lanes are frequently indented into the shoulder, to provide decelerating lanes, so that traffic will be out of the way while slowing down to make the turn when not stopped by a red light, while through traffic continues in the center lanes.

CONTROLLER IS ALERT

The controller is so arranged that it gives preference to heaviest movement and automatically changes if the heavy flow should suddenly change. And, believe it or not, the controller is influenced by the speed of traffic, so that if a lull or blank space occurs in a heavy, continuous stream of vehicles the controller will instantly put the vehicle through that has waited the longest; that is, it will give it the green light, sometimes so quickly the driver misses it if he is not watching carefully.

It is all very confusing to talk about but really quite simple, as shown in the accompanying pictures of East Shore Highway intersections in Contra Costa County where such installations handle as much as five thousand vehicles in one hour.

Traffic Signal Control is amplified by channelization islands and separate lanes for turning vehicles

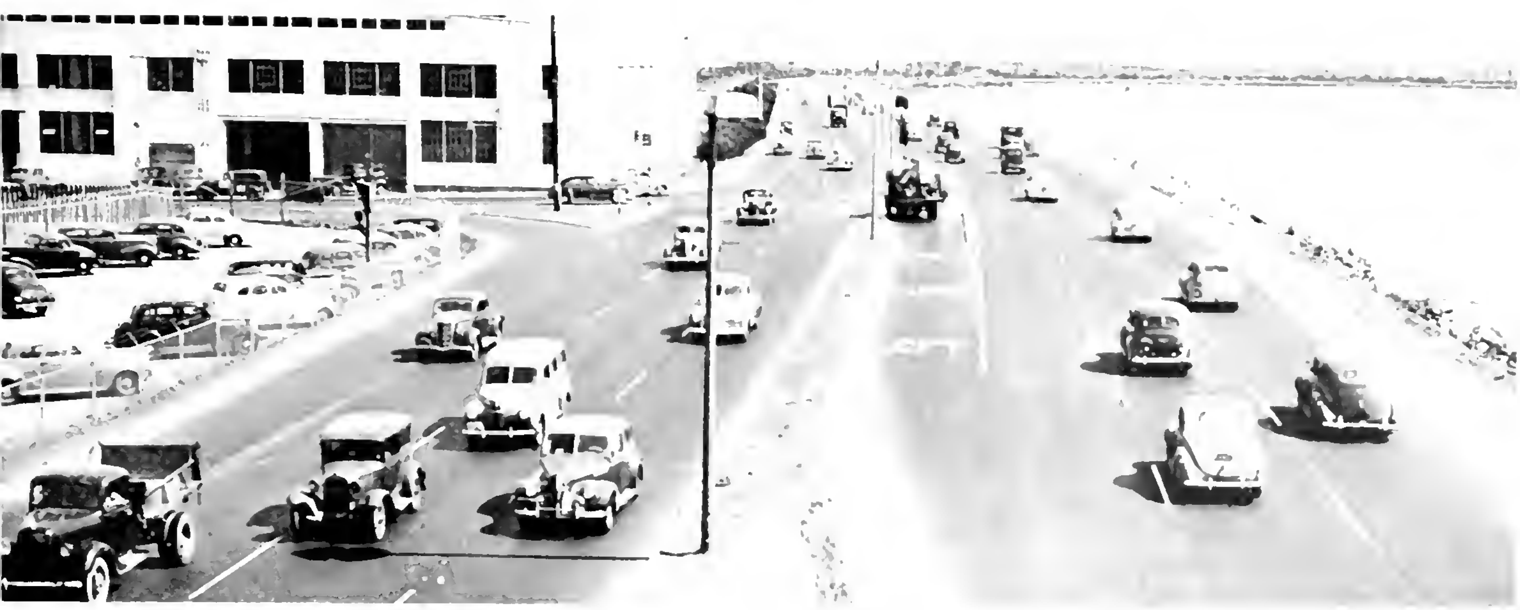
and forty to forty-five thousand a day.

PEDESTRIAN GETS BREAK

At some intersections, particularly in the defense industrial area of the city of San Diego, where there is a heavy pedestrian traffic across heavily traveled streets, control buttons are placed so that the pedestrian is not obliged to wait unduly or jump and run to get across but can get a green light by putting a call through to the controller via the push-button.

Traffic controls at intersections of heavily traveled highways present a perplexing problem and rarely are identical conditions found to exist. There is something different at each intersection—something that requires a little different adjustment. Storage lanes may need to be a little longer; decelerating lanes may not be required; more signal indications may be needed or a slight change in position because of the effect of the afternoon sun; or a different arrangement of traffic islands may be advisable.

It all depends on the traffic pattern, how much turning left or right, the number and size of trucks and the physical conditions such as right of way width, approaching grades, speed of traffic and alignment at the intersection. But by making a proper balance of all the many influencing factors, traffic can be helped to handle itself until conditions compel the construction of a grade separation, when traffic can proceed without crossing the path of any other traffic.



Indentation of the median strip provides a waiting or storage lane for vehicles turning left and avoids holding up through traffic

Widening of U. S. 101 Eliminates Traffic Bottleneck in San Mateo County

By G. A. WILDMAN, Resident Engineer

UNDER a recently completed contract, which called for widening as well as resurfacing of the old pavement, one of the last serious bottlenecks on El Camino Real (U. S. 101) in the County of San Mateo, has been eliminated.

The contract,* 3.2 miles in length, covers that portion of El Camino Real between Charter Street, in Redwood City, on the north, and San Francisquito Creek, the county line of San Mateo and Santa Clara counties on the south, and passes through the town of Atherton and the city of Menlo Park.

Under previous contracts let over a period of several years the old highway had been widened and resurfaced both north and south of the recently completed section.

Under one contract let in 1930, San Francisquito Creek Bridge was widened and the highway was reconstructed to a width of 40 feet with 7-foot shoulders south of the bridge in Santa Clara County.

On the north, under a more recent contract through Redwood City, the traveled way was reconstructed to a width of 70 feet with 7-foot shoulders, giving three 11-foot traffic lanes each side of a 4-foot division, making an over-all width of roadway of 84 feet.

The same general plan of construction on the contract just finished was followed as in the case of the Redwood City project, except that in general the over-all width of the finished roadway is 88 feet, providing 7-foot shoulder areas with two 12-foot and one 11-foot traffic lanes each side of a 4-foot division strip.

The exceptions to the above were on sections where curbed islands were provided, with a maximum width of 28 feet for channelization; also through a portion of the city of Menlo Park, where the over-all width of the traveled way, including shoulder or parking area, was reduced to 84 feet, leaving 8-foot sidewalk areas.

The history of the original construction and reconstruction of this portion of El Camino Real, obtained from various sources, is as follows:

Previous to 1912 or 1913 the traveled way consisted of a graveled roadbed, maintained during the dry seasons of the year by frequent sprinkling with

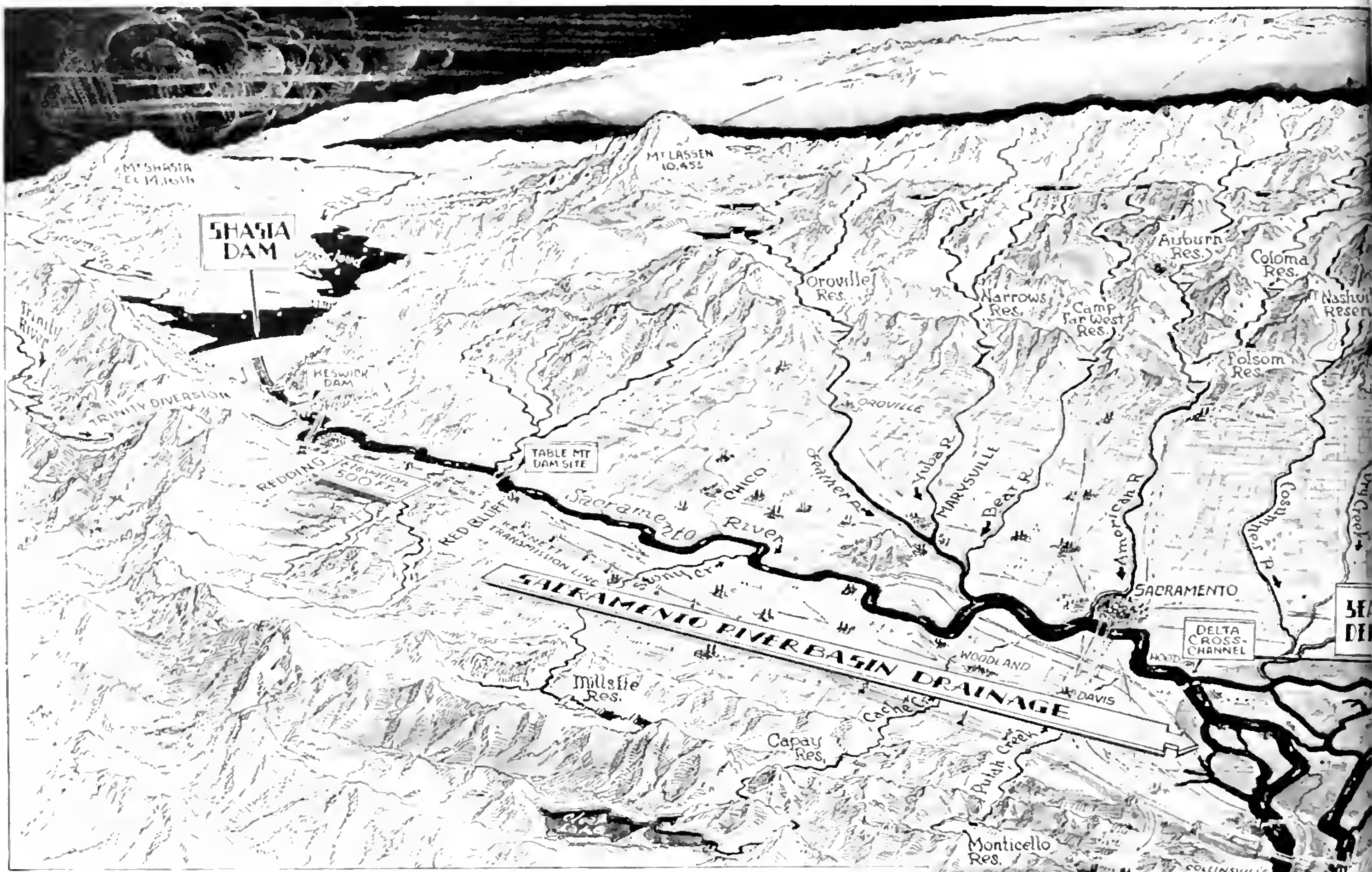
(Continued on page 12)

* This contract was awarded October 29, 1941, before Federal restrictions were placed on highway construction.

Typical view of widened section of U. S. 101 near Atherton providing a 6-lane divided highway

Top, improved section of U. S. 101 showing channelized division strip approaching Atherton. Below, widened avenue through Menlo Park

California's Water Plan for Dev



24 Major Storage Reservoirs

TWENTY years before the terms "long-range" and "postwar" planning became national by-words, California prepared a program of regional development for the solution of the State's major water problems. Today this program is paying dividends as evidenced by construction of the Central Valley Project with Federal funds. Other kindred conservation projects of the program are presently under serious consideration by Federal agencies.

The California legislature in 1921, taking cognizance of the fact that the State's future development was definitely linked to the amount of water available for agricultural, industrial and domestic use, appropriated funds for a survey of the State's water resources. During the ensuing years additional legislative appropriations were provided and exhaustive studies of California's complex water problems were carried out under the direction of the State Engineer. These studies resulted in a series of reports which are summarized in Bulletin 25, State Division of Water Resources entitled "The State Water Plan." This plan was adopted by the legislature in 1941.

This plan constitutes one of the most outstanding examples of regional planning of water conservation, control and utilization in the nation. It is designed not only to overcome the unequal geographic distribution but also the unequal seasonal distribution of water supply in the State. The plan for the Sacramento and San Joaquin River basins is shown in the accompanying perspective map. It provides for the construction or utilization of twenty-four major storage reservoirs with an aggregate capacity of nearly 18,000,000 acre-feet of water, 18 power plants capable of producing 7,000,000,000 kilowatt hours of electricity annually, and the use of underground storage reservoirs particularly in the San Joaquin Valley.

ping the Great Central Valley

Irrigation for 10,000,000 Acres

Large capacity canals and pumping systems are planned to transfer this water from areas where a potential surplus exists to areas where supplies are deficient, with exchanges of water on the San Joaquin and Kern Rivers. It would furnish ample supplemental water for all domestic, municipal and industrial uses in the great Central Valley and the San Francisco Bay region and for the irrigation of 10,000,000 acres of land in those areas.

The storing of storm waters in these foothill reservoirs and their release during the dry season will (1) control floods, (2) improve navigation on the Sacramento River, (3) supply lands tributary to the streams down which they pass, (4) control salinity in the Sacramento-San Joaquin Delta, (5) supply the delta pool with surplus water which may be transferred to the San Joaquin Valley and San Francisco Bay region, and (6) produce large new sources of electric power.

Key to this master plan of water conservation and utilization is the natural storage basin at the confluence of the Sacramento and San Joaquin Rivers. It is an area, approximately 40 miles long and 25 miles wide, which lies at sea level and is crisscrossed by 500 miles of waterways. Into these waterways flows unused runoff from both river systems, averaging 31,000,000 acre-feet a year. Flood waters stored in the various proposed reservoirs can be fed through natural channels into this great natural pool as required and pumped from there into the San Joaquin Valley and other areas where supplies are needed. Importance of this delta storage is that when the water has reached this point all upstream requirements have been met and the surplus water under normal circumstances would waste into the sea.

Backbone of the State Water Plan in the Central Valley Basin is the Central Valley Project, now under construction by the United States Bureau of Reclamation. This project was selected by the State as the initial unit of the State Water Plan for construction, but the entire plan is so integrated that other units may be added as the need arises.

Widening U. S. 101 Eliminates Bottleneck

(Continued from page 8)

water wagons to keep the dust down, and worked with horse-drawn blades and drags to keep the roadway in a more or less smooth condition. During the wet season the roadway was maintained by keeping the holes filled with additional gravel and occasionally bladed or dragged, thus maintaining a suitable roadbed.

FIRST PAVING IN 1913

The first construction involving any paving was done in 1913, and provided a traveled way 20 feet wide of 1½-inch asphalt concrete pavement on a 5-inch macadam base. The traveled way was widened to 30 feet in 1925.

The roadway thus provided gave satisfactory service for many years, but due to increased traffic, heavy hauling, and the widening of the highway at each end, the volume of traffic fed to this section has been so great that serious congestion resulted.

Under the recent reconstruction, additional right of way had to be provided; this was in the main acquired along the westerly side of the old right of way and varied in widths from 26 feet, at the beginning of the project, to 55 feet in the vicinity of the island areas provided for channelization.

The acquisition of new right of way was a big job in itself and presented several difficult problems. In the city of Menlo Park several large buildings, including a reinforced concrete theater, had to be moved or remodeled, and one large two-story brick building with a full basement was completely demolished and the basement backfilled.

EARTHQUAKE EFFECTS SHOWN

This building had been erected previous to the earthquake of 1906 and had apparently withstood the quake without any damage, yet when the wreckers started to tear down the walls it was evident that the earthquake had loosened the brick in the mortar as they were removed without any difficulty and came out very clean.

Between Station 557 and the beginning of the project at Redwood City—a distance of 12,590 feet—there is only one intersecting waterway. This is at Atherton Creek, a distance of 1,116 feet from the summit. Southward towards the end of the project there is a sag in the grade, the low point being at Station 590, elevation 58.54 feet and rising within a distance of 1,000 feet to an elevation of 72.52 feet, the top of the bridge deck at San Francisquito Creek.

STORM DRAIN INSTALLED

The flow line of San Francisquito Creek is at an approximate elevation of 46 feet, or only 12½ feet lower than the elevation of the highway at the low point of the sag. To drain this low sag and the street intersections on the westerly side of the highway in the business district of Menlo Park, a reinforced concrete pipe storm drain was placed starting at Santa Cruz Avenue, and running southward to empty into San Francisquito Creek, a distance of 4,200 feet. The diameter of the pipe varied from 15 inches at the beginning to 30 inches at the outlet.

LITTLE SHORING NEEDED

Very little shoring was necessary to support the walls of the trench, as the material excavated was of such a nature that it would stand nearly vertical, but as a precaution the contractor sloped the cut banks quite heavily and installed intermittent shoring during the progress of the excavation through the heavy cut sections.

Backfilling immediately around and over the pipe was done by hand. The material was placed in layers, jetting was permitted due to its sandy nature, but final compaction of each lift was done with a caterpillar tractor and sheepsfoot tamper. A caterpillar with bulldozer kept the backfill leveled up ahead of the tamping.

The roadway was widened each side of the old 30-foot asphalt concrete pavement, but mainly on the westerly side. New construction consisted of the removal of approximately 39,500 cubic yards of roadway excavation, the placing of 70,000 tons of imported borrow, and 43,000 tons of asphaltic concrete.

ASPHALTIC CONCRETE SURFACING

The imported borrow was placed to form a base 1 foot thick under 6 inches of asphaltic concrete on all widened areas. The thickness of the asphaltic concrete surfacing over the old 30-foot pavement varied, but the new grade was maintained at an elevation that would provide a minimum of 2 inches of new surface over the old. The shoulders, or parking strip areas, were surfaced with plant-mix, except through Menlo Park where concrete curb and gutters were placed. Asphaltic concrete or portland cement concrete surfacing was placed on the shoulder areas adjacent to the new curb and gutters.

The contract was awarded to the Union Paving Company of San Francisco on October 29, 1941, and approved on November 19, 1941. Actual work was started on December 2, 1941. Due mainly to the outbreak of war, the contractor was unable to obtain labor, materials and supplies as readily as was anticipated, and the job was not completed until June 15, 1943. C. L. Corson was general superintendent for the contractor, and A. W. Jagow was job superintendent.

All work was done under the direction of the Division of Highways and under the general supervision of District Engineer Jno. H. Skeggs of District IV, San Francisco. Resident Engineer H. S. Payson was in direct charge of the work preceding his death on December 25, 1942. The work was completed under the supervision of G. A. Wildman as Acting Resident Engineer.

Trucks Hauling Livestock

Tonnage of livestock hauled from farms to market via truck in 1942 again set an all-time record, according to reports forwarded to the Automobile Club of Southern California. Trucks delivered 62.8 per cent of cattle, hog and sheep tonnage, and surveyors estimate that it would have taken 830,000 railroad carloads to transport this volume.

Young Man: "I think two can live as cheaply as one."

Future Father-in-Law: "You can't edge into my family on that theory, young man. I'm willing to keep supporting my daughter, but you'll have to pay board."

Highway Committee Recommendations For Selection of Culvert Size and Type

By G. A. TILTON, Jr., Assistant Construction Engineer

FOREWORD

This is the ninth of a series of technical abstracts from a joint departmental review of culvert practice of the :alifornia Division of Highways by a committee composed of R. L. Thomas, Assistant Engineer Surveys and Plans; C. F. Voodin, Assistant Maintenance Engineer, R. Robinson Rowe, Assistant Bridge Engineer, and the writer.

In its most important conclusion, the committee found that the usual practice of designing culverts for a 0-year flood with unbalanced freeboards (height of parapets) was uneconomic, and proposes instead: that the culvert nd its appurtenances be balanced without freeboard for a 100-year flood. A procedure is outlined to facilitate selection f the most economic combination for a particular site.

A balanced design providing for safe passage of the 100-year flood under head does not generally increase cost ver the current practice of providing for the 10-year flood without head.

IT has been recommended in a previous article * that a culvert be designed to pass a 10-year flood without static head on crown of culvert at he entrance; and that the design of he culvert and appurtenances be balanced to avoid serious damage from head and velocity obtaining in a 100-year flood—noting that some exceptions to these rules would be discussed n a later article.

Application of these rules to the conditions at a particular site will result in a long list of alternative combinations of conduits and appurtenances which are hydraulically equivalent.

The more experienced the designer, the shorter the list of alternatives, many of which can be discarded at a glance as impractical or uneconomical. The combinations retained for consideration must then be compared as to cost and practicability before making a final selection.

The committee has suggested a procedure for (a) listing alternative combinations, and (b) discarding certain combinations as impractical—adding other principles which will assist in reducing to a minimum the number of combinations for which cost should be compared.

Current Practice

Although there have been notable attempts to use newer theories for larger culverts, most culvert design is still based on formulae equivalent to the first rule—that a 10-year flood pass without static head on crown of culvert at entrance. This is approximately equivalent to application of the Talbot Formula, which is used to some extent * (1) by 36 States. The A. A. S. H. O. (2) states the general rule: "In general, culverts shall be proportioned to carry the maximum flood discharge without head."

If the "maximum flood discharge" just reached the crown of the culvert entrance, so that flow would be "without head," then there would be no need for headwalls above that level, and parapets would serve only to retain the highway embankment. However, as reported by every maintenance man consulted by the committee, a large proportion of culverts are subjected to considerable head on the entrance, wherein parapets serve the further purpose of protecting the embankment from erosion.

Headwalls are overtopped much more often than endwalls and to a much greater degree (see Fig. 59a), suggesting that parapet elevation should not be determined arbitrarily, but from hydraulic study.

Application of the first rule alone ignores the opportunity for reduction of the culvert section below the entrance if there is a fair (supercritical) slope available.

It is a matter of common observation that the outlet is far from full when the entrance is just full. Actually, the water surface drops rapidly inside the entrance, and a large portion of the waterway is never utilized. In the case of a culvert selected by the first rule; increasing a slope beyond the supercritical slope does not increase capacity of the culvert.

For the past 20 years, solutions have been proposed by department engineers from time to time to correct the uneconomic practice, such as by the use of belled entrances to pipe culverts and tapered barrels in concrete boxes from entrance to outlet. For various reasons progress ended with experimental installations.

Balanced Design

As one step in the improvement of this practice, the committee proposed the second rule. Instead of constructing headwalls, endwalls and other facilities to arbitrary freeboards, the combination of culvert barrel and all appurtenances should barely satisfy for the 100-year flood (limiting flood) without any freeboard (see Fig. 59b).

The limiting flood has been designated the "design discharge" and has been given an approximate frequency of once in 100 years. It is an "ultimate capacity" of the system, beyond which there may occur still greater floods which will damage all parts of the system (perhaps destructively).

To be specific, balanced design is defined as that combination of conduit section, shape, texture and gradient with entrance and outlet appurtenances which will just pass a 100-year flood without interruption of traffic and without serious damage to structure, embankment or abutting property.

* California Highways and Public Works, September, 1942, page 10

* Numerals in parentheses refer to [illegible] at end of article.

To obtain such balance, the designer must know the stages and velocities at critical points of a trial layout and the durability of structure, embankment and natural channel where exposed thereto.

Computation of these items for a large number of culverts becomes a tremendous task. Tables are available for certain kinds of pipe and for short culverts, but the committee was unable to find any compact combination of tables and charts available to cover the design field applicable to the widely variable California conditions.

The formulae developed by the University of Iowa (3) after tests in cooperation with the Bureau of Public Roads (now the Public Roads Administration) were found applicable to all designs of the California Division of Highways. Since the tests in the Iowa experiments were limited to pipes up to 30 inches in diameter and concrete boxes up to 4 feet by 4 feet in size and 30.6 feet in length, any set of working tables or working charts to cover current practice requires extrapolation to six times the diameter and length of the test units, which is a reasonably small prototype-to-model scale ratio.

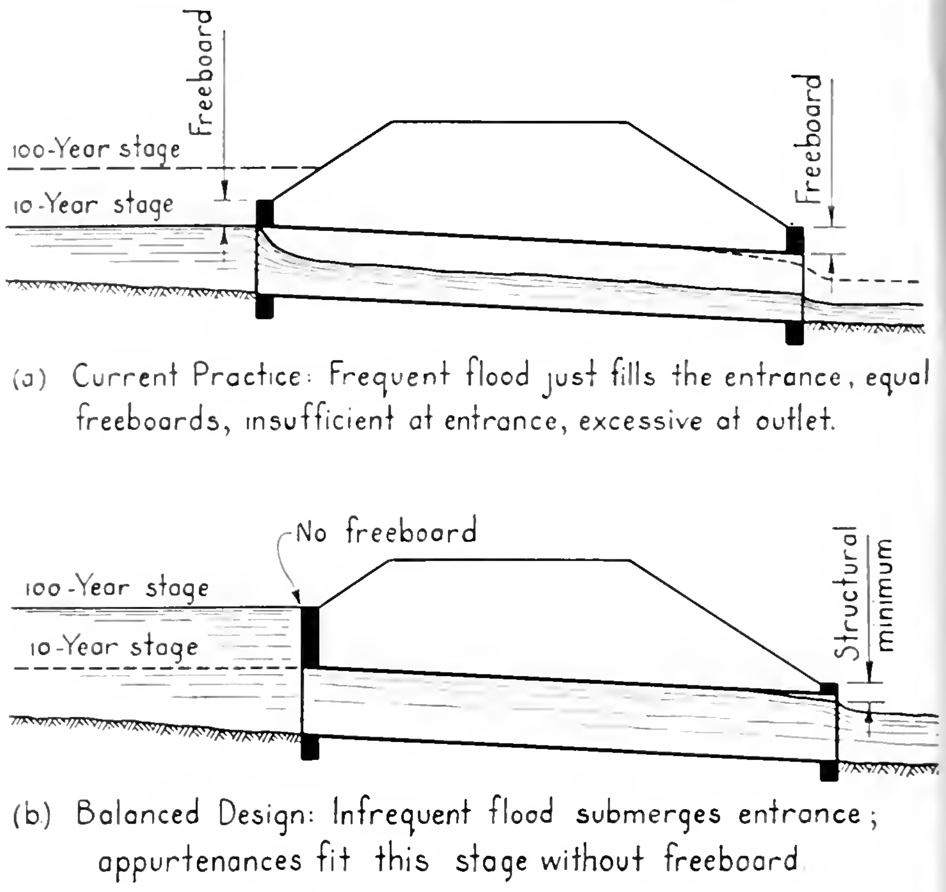


FIG. 59. Comparison of controls for current practice and balanced design for free-outlet culvert on supercritical slope

Balanced Design Procedure

The steps recommended for balanced design of culverts can be summarized briefly as follows:

(a) Determine from maps, highway records and field study; the basic data required for Chart A* and for application of at least one culvert formula, and for at least one field estimate of flood discharge.

(b) Compute and compare discharges. If culvert formula leads to a waterway area, take the design discharge in second-feet at 15 to 18 times the area in square feet. Anticipate that recent high water marks may represent a flood of anywhere from 30 to 120 per cent of the 100-year flood. If differences are reasonable, select a weighted mean; otherwise, analyze the data and allow for the effect of unusual factors.

(c) By preliminary application of engineering factors (list follows) eliminate from further consideration any type which should not be used at the particular site.

(d) Determine minimum sections by use of Chart D** for a 10-year flood, which may be taken at 55 to 65 per cent of the design discharge. Modify this minimum if required by items d'.

* See September 1942 California Highways and Public Works.

** See November 1942 California Highways and Public Works.

d' For large free outlet culverts, the 10-year flood in second-feet should not exceed 10 times the rated waterway * of the section in square feet.

(e) Apply working charts or pertinent formulae to the minimum sections to determine head on the culvert, and compute the headwater stage. If this stage is too high, use the allowable stage and determine the cheapest conduit which will satisfy this restriction.

(f) Study conditions at the entrance with the help of profile or site plan and consider the effect of headwater pool on natural channel, upstream property and the highway embankment. For each design still being considered (2 or 3 at most) estimate the cost of reasonable protection without freeboard. As part of this step, it may be advisable to modify the tentative section selections.

(g) Establish grades or gradient of culvert flowline and estimate velocities at outlet for both the 10-year flood and the design discharge (100-year flood).

(h) Study conditions at the outlet and consider the effect of high velocity, eddies or other turbulence on natural channel, downstream property and the highway embankment. For each design, estimate the cost of reasonable protection—against nominal loss in 10-year floods and against serious loss in 100-year floods. Include energy-dissipator in estimate, unless it can be shown that maintenance charges after damage will be less expensive.

(i) Estimate the annual cost, including anticipated maintenance, of each tentative balanced design of culvert and appurtenances. For the larger structures, this may include a credit for displaced embankment; for some box culverts there may be a credit for displaced subgrade and slab.

(j) Select the most economic combination, giving reasonable weight to the following engineering factors and departmental policies.

* See May-June, 1943, California Highways and Public Works.

Engineering Factors

There are five principal engineering factors which should always be appraised before final selection is made:

(a) Character and stability of underlying foundation material on which culvert is to be laid.

(b) Nature and extent of lateral rces acting in the covering embankent.

(c) Effect of earth loads from high nbankments.

(d) Effect of impact under shalw earth cover.

(e) Accessibility of culvert site.

In special cases, minor engineering onsiderations may be sufficient to dermine type, such as:

(f) Salvage value where installaons are temporary.

(g) Facility of extending existing ılverts.

(h) Adaptability to jacking under avements.

(i) Resistance to alkali, salts, and cids.

(j) Resistance to abrasive action of one-laden stream flow on the invert.

(k) Desirability of eliminating adwalls by cantilevering extensions.

(l) Advantage of contracts, reected in bids, of using one type of ulvert throughout the contract.

oundation and Earth Loading Conditions

The effect of earth loads on flexible nd rigid culverts laid on yielding and nyielding foundations has been treat-l in detail in the seventh article of his series.*

Commercial culverts of both the exible and rigid types are limited as safe height of fill. Above such limiations it becomes necessary to design monolithic types to support the eight of the high over-fill.

Pipe culverts laid on excessively ielding foundations and culverts laid nder embankments on sidehill are liale to lateral movement and should be f the type that best resists disarticuation. Flexible pipes in long lengths f heavy gage, with extra long collars ave proven more satisfactory in such ases than short length sections of rigid ypes.

ccessibility of Culvert Site

For pioneer roads in mountainous ountry and similar inaccessible locaions where deep gulches are encountered, the deciding factor in selection f type may be the speed with which he installation can be made and contruction progress expedited. Long ections of the flexible type, light in veight, are readily adaptable to such ocations.

* See March-April 1943, California Highways and Public Works.

Departmental Policies

Selection of size or type of culvert may be finally determined by departmental policy such as:

(a) Adopted minimum size of culvert for maintenance purposes—for instance, minimum 18-inch pipe culverts under shallow fills or minimum 24-inch under high fills.

(b) Limitation of unproven types of culverts to experimental installations.

(c) Conformance with specification policies of participating governmental agencies.

(d) Conformance with national governmental dictates in critical periods.

Committee Recommendations

Summarizing its findings, the committee recommends generally that:

(1) Current practice in selection of size and type of culvert should be rationalized.

(2) With few exceptions, a balanced design of barrel and appurtenant structures will be the most economic combination.

(3) The balance should avoid all but nominal loss in 10-year floods and assure against interruption of traffic in a 100-year flood, without providing freeboard for greater floods.

(4) Design should achieve such balance by careful but simple and progressive steps, as outlined.

(5) While hydraulic requirements should never be overloooked and least annual cost is a strong argument, final choice should not be made without consideration of listed engineering factors and matters of policy.

(6) It should be recognized that each type of culvert enjoys advantages for some particular situation—smooth barrels for hydraulic efficiency, corrugated barrels for steep gradients, flexible pipe on yielding soils, monolithic sections for large waterways, arches under the highest embankments—but that the conflict of these advantages requires an open-minded examination of many other factors at each site.

LIST OF ARTICLES ALREADY PUBLISHED IN CALIFORNIA HIGHWAYS AND PUBLIC WORKS

August, 1942—Preliminary outline of articles.

September, 1942—Comparative Hydrology Pertinent to California Culvert Practice.

October, 1942—Debris Control at Culvert Entrances on California State Highway System.

November, 1942—Highway Culvert Location and Slope From a Review of California Practice.

December, 1942—Culvert Entrances and Headwalls on Calfornia Highway System.

January, 1943—Culvert Outlets and Endwalls on California Highway System.

February, 1943—Utilization of Syphon Principles in California Culvert Practice.

March-April, 1943—Earth Loading Factors Affecting Field Installations of Culverts.

May-June, 1943—California Adopts Waterway Ratings for Large Drainage Culverts.

Bibliography

(1) Determination of Waterway for Structures. V. W. Enslow in Convention Group meetings, 1942, p. 103 (A.A.S.H.O.

(2) Specification 3.1.5, Highway Bridges, 1941 A.A.S.H.O.

(3) Flow of Water Through Culverts (Bulletin 1, University of Iowa, Studies in Engineering, 1926).

E. M. Maurer Retires as Superintendent of Maintenance

The retirement of Highway Maintenance Superintendent E. M. Maurer is announced by District Engineer E. Q. Sullivan of District VIII, San Bernardino.

"It was with extreme regret that we received the resignation of Mr. Maurer," said Mr. Sullivan. "Mr. Maurer resigned, having reached the age of retirement.

"I think there is no more able maintenance superintendent in the State service than Mr. Maurer, at the time of his resignation. He has been employed by the State for almost 25 years and has been Maintenance Superintendent for approximately 14 years. His assignments were first in the Imperial Valley and then on the desert, with headquarters at Barstow.

"Mr. Maurer preferred a desert assignment and was permitted to remain on the desert for this reason, though he had been offered what many consider to be more desirable assignments off the desert.

"It was hard to realize that Mr. Maurer had reached the age of retirement. He retained the spirit of youth and was active and highly efficient.

"All of the friends of Mr. Maurer in the State service wish him many years of health and happiness in his retirement."

Improved Saw For Cutting Concrete and Rock Specimens For Laboratory Inspection and Tests

By ALLEN NICOL and GEORGE POMEROY*

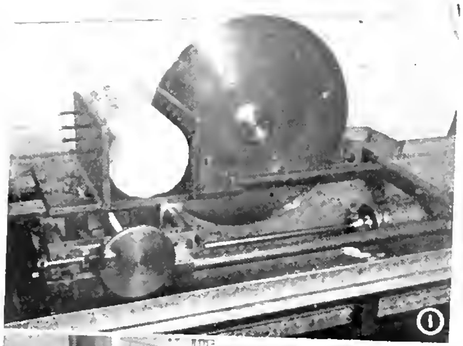
In recent years, considerable research on concrete and concrete aggregates developed the need for an improved type of sawing equipment to prepare portions of specimens for examinations and tests. A small diamond saw, designed and made in the machine shop of the Materials and Research Department, had given satisfactory performance for the preparation of thin-sections of small (2″ maximum) pieces of rocks and concrete for petrographic studies. As the scope of investigational work increased, the need developed for sawing equipment of larger magnitude. It became necessary to saw large pieces of concrete pavement slabs, cores, and cylinders, as well as mortar bars of various sizes, large pieces of ledge rock, and gravel aggregates.

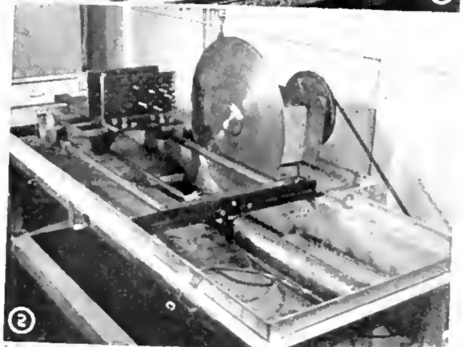
Experience with the small saw established several important features to be incorporated in a larger machine. Before plans were drawn, several inspection trips were made to firms and lapidarists to investigate the design and efficiency of sawing equipment already in operation. Many desirable features were observed, several of which were incorporated in the new machine. The less desirable features were avoided wherever possible.

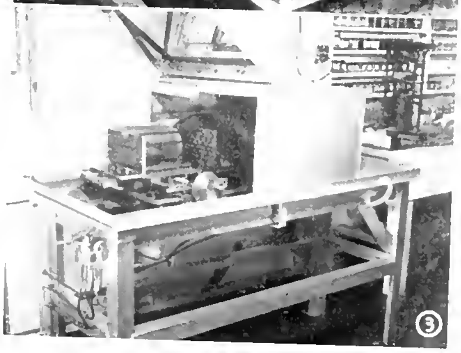
Specifications for Proposed Equipment

The following requirements were set up for the new saw:

1. Capacity of the saw to accommodate not less than a 6″ x 12″ specimen.
2. The cutting disc to run in a mixture of kerosene and oil.
3. A clamp or vise to quickly and securely hold irregular shaped specimens.
4. The feed or pressure of the specimen against the cutting disc to be under complete control of the operator at all times, and to be variable at will. To accomplish this it was decided to use hydraulic pressure from the city water mains, a method so far as is known to the writers, never before used in this type of equipment.
5. The production of uninjured, smooth cut surfaces in a minimum of time.
6. Use of such materials as were in stock, or readily obtainable.







Construction of Machine

As constructed, the sawing element consists of a 20″ diameter diamond studded 14 gauge steel disc mounted on a ball bearing spindle, with a pulley on the other end belted to a $\frac{1}{3}$ horsepower electric motor. The speed of the cutting edge is 2200 feet per minute. It dips approximately 1″ into a mixture of 50 per cent SAE #20 oil and 50 per cent kerosene.

In making the saw, the edge is first rolled to a width of $\frac{1}{10}$″ and to a depth of $\frac{3}{64}$″; after which it is cross-cut each $\frac{1}{4}$″ of the circumference. The cross-cuts have a width of .028″ and a depth of $\frac{1}{32}$″. No. 60 mesh diamond chips are placed in the cross-cut slots, which are then lightly peened. After completing the diamond setting, the disc is re-rolled to force the metal firmly around the diamonds, but still maintaining the $\frac{1}{10}$″ width.

The saw is then mounted on the arbor of the machine, and with a medium grade carborundrum block in the specimen holder, the machine is operated with a light pressure to wear off the surplus metal, thereby exposing the diamonds in the cutting edge. As soon as the diamonds are exposed and start to cut the carborundrum block, the saw is ready for use.

The specimen holder consists of an adjustable vise. The jaws of the holder are made of $\frac{1}{2}$″ x 6″ x 4″ x 10″ long angle iron drilled and tapped for $\frac{5}{16}$″ standard set screws on approximately 1″ centers over the entire face. One jaw is stationary and the other adjustable over a range of 12″ in one-inch increments. The holder is mounted on a carriage sliding on round rods and travels in a direction at right angles to the axis of the saw arbor. This movement forward and back is obtained by water pressure in either end of a brass cylinder, one end being anchored to the frame of the machine, with the piston rod attached to the carriage. A cross adjustment is provided to regulate thickness of slices cut. One-inch

* Respectively Mineral Technologist, and Machinist and Instrument Maker, Materials and Research Department, California Division of Highways.

diameter cold rolled steel rods were used for the longitudinal ways of the carriage and the cross adjustment. These roads were held securely and parallel at the ends by insertion in one-inch holes drilled and reamed in 1″ by 1½″ rectangular cold rolled steel bars bolted to the cross members. Bronze blocks bored to 1″ were used as the sliding members.

Water pressure to operate the carriage is obtained from the city mains, with the utilization of full pressure, which seldom exceeds 40 pounds, for either advance or return movement of the carriage. Reduced pressure, usually 1 to 5 pounds is used during the sawing operation and is obtained by means of a pressure regulating valve. A specially designed rotary type valve in which both full and reduced pressures are controlled simultaneously is conveniently located for the operator. Gauges show both main line and reduced water pressures. The water cylinder is made 2½″ standard brass pipe having ordinary 2½″ pump leathers. The piston rod is ⅞″ diameter round bronze, with a maximum travel of 23″. The total pressure required for cutting is from one to five pounds per square inch on the piston, depending on the nature of the material.

Provision was made to lower the saw arbor to cut long specimens, thus enabling the work to pass over and clear the saw collars. On all smaller work the saw arbor is on a level with the center of the specimen. A suitable frame welded out of angle iron supports the working units. There is a sheet metal pan under and a splash hood over the saw.

The average time of setting up and cutting a 5″ diameter concrete specimen is less than four minutes. A similar 6″ diameter specimen can be cut in less than six minutes. This is at the rate of about 4 to 5 square inches per minute. The cutting rate for quartz crystal is two square inches per minute.

Slices as thin as $\frac{1}{32}$″ have been cut without difficulty when the material was sufficiently dense and sound not to break during the sawing operations. The cuts on all materials thus far have been smooth enough to polish without preliminary lapping. The feed control is instantly responsive to the will of the operator. Saw life has exceeded all expectations. In six month's operations over 5,000 square inches of surface have been cut in all kinds of material with little indication of total saw life. The saving of time in preparing specimens for study has been 300 per cent in some cases. The life of the saw and smoothness of the finish is no doubt largely attributable to the method of applying and controlling the feed and the design of the cutting edge.

The uses to which the new saw has thus far been put include the following:

Cutting 6″ diameter concrete cylinders of 12 inch length from end to end for visual examination. Also cutting slabs of various thicknesses. The prepared surfaces thus produced afford good means of ascertaining such features as water gain and voids, distribution of aggregate, bond, etc.

Cutting ends of concrete cores preliminary to capping for compressive strength test.

Obtaining smooth surface of concrete in suitable size for observation and study under binocular microscope.

Sawing concrete to expose unaltered areas or features that might otherwise be destroyed by breaking with hammer.

Sawing weather ledge rock or gravel aggregates for the purpose of studying the depth and extent of weathering, surface coating, internal structure, fractures, etc.

In addition to the above, the machine has on various occasions been used for cutting tops or bottoms off large bottles and other glassware; sawing pieces of thick plate glass; cutting fire brick to odd sizes and shapes, pieces of tile and porcelain, mortar bars and brickettes, etc.

In Memoriam

J. D. Greene

The death of John D. Greene, Associate Highway Engineer in Central Office, came suddenly on June 4, 1943.

Jack Greene was one of the old timers in California State highway construction. He first came to work for the California Highway Commission in February, 1912, as an instrumentman on survey parties and continued in that capacity until he entered the Engineer Corps of the Army in 1918. He served overseas in World War I and had attained the rank of Captain of Engineers at the time of his discharge in July, 1919. After termination of his military service he returned to California and for a period of six months was employed on State highway construction. From 1920 to 1926 he worked on highway construction for Sutter County and for the State of Nevada, returning again to the California Division of Highways in May, 1926, as a Resident Engineer in charge of construction projects.

Mr. Greene worked on construction in Districts IV, V, and X, but the greater part of his service was in District III.

In May, 1940, a heart ailment forced Mr. Greene to give up the more active duties of supervising construction in the field and he was transferred to headquarters, where he was employed on the staff of the Office Engineer until his death.

Mr. Greene's passing marks the loss to the Division of Highways of a most capable engineer who had served the State over a long period of years. True to his profession he has left behind him monuments of concrete and asphalt on some of the best highways in Central California, which will serve the traveling public for many years to come.

He was most popular among his coworkers and there are many of the younger construction men in the department who look back with pleasure to the training in the best of construction practice which they received while working under his supervision.

The Division of Highways extends sincere sympathy to Mrs. Greene and Jack's daughter, Mrs. Curtis Nelson.

Women Employed to Work on Highways

TWO women have recently been employed on highway work in District IX, working out of the Conway Summit Maintenance Station. These women are now assigned to guard-rail painting and will be gradually instructed in other lines of maintenance work for which they are physically capable and show an aptitude.

Women have been employed as census takers for many years during the mid-year and monthly traffic counts, and in District I have been used successfully as flagmen.

"In view of the remarkably efficient record made by women in what we usually considered man's particular field," said T. H. Dennis, Maintenance Engineer, "we have no doubt but what they will prove very helpful and satisfactory in our maintenance work. This type of outdoor work should have a particular appeal to women, and it is hoped that many of the other districts will be able to recruit women help, as the labor shortage is now critical.

California Highways Meeting Extraordinary Demands

Miscellaneous motor truck receipts at San Francisco in 1942 totaled 16,536 carload lots

[illegible] Nevada, Oregon [illegible] During [illegible]

In 1942, 74,467 carload lots of 38 important vegetables and fruits were unloaded in Los Angeles and of this amount 81.1 per cent was transported by trucks, 15.6 per cent by rail, 3.2 per cent by boat and .1 per cent by express.

During 1942, 24,853 car lots of 38 important fruits and vegetables were unloaded in San Francisco, 66.5 per cent by truck and 32.8 per cent by rail.

[illegible]

[illegible] North San Francisco Bay [illegible] Sacramento Valley, San Diego County, San Francisco Bay district, San Joaquin Valley, Santa Barbara, San Luis Obispo and Los Angeles [illegible]

[illegible]

[illegible] Los Angeles from Arizona [illegible] Massachusetts [illegible] New Mexico, Ohio [illegible] Texas, Utah, Washington [illegible]

[illegible]

Sacramento Valley, San Joaquin Valley, Monterey and Santa Cruz counties, San Luis Obispo and Santa Barbara counties, Los Angeles, Coachella Valley, Imperial Valley and San Diego [illegible]. The truck receipts from out of State points totaled [illegible]

Shipments of hay by truck to Los Angeles from the Antelope Valley April through September, the first six months of the 1942-1943 season, were reported [illegible] tons. Movement of hay by truck from Imperial Valley to Los Angeles April [illegible] September 1942 totaled [illegible]. Shipments from the San Joaquin Valley counties, Fresno, Kings, Tulare and Kern, were unusually [illegible] by trucks.

With the beginning of the war the truck industry had to assume additional heavy burden in the movement of [illegible] produce, livestock, etc., because the railroads were devoting [illegible] and short hauls to military and naval material.

Highway Bids and Contract Awards for June and July, 1943

BUTTE, PLACER, SACRAMENTO, OLO, COLUSA, GLENN, YUBA AND UTTER COUNTIES—Repairing by apying a seal coat to various locations. Disict III. E. A. Forde, San Anselmo, $41,-6; Louis Biasotti & Son, Stockton, $48,329. ontract awarded to W. C. Railing, Redwood ity, $36,397.

BUTTE COUNTY—Across Pine Creek verflows about 7 miles west of Chico, two inforced concrete bridges to be constructed. istrict III, Route 47, Section A. James H. cFarland, San Francisco, $34,646; James . Allen, San Carlos, $39,614; Wm. E. homas Concrete Construction Co., Sacraento, $40,090; Dan Caputo, San Jose, $44,-0; J. S. Metzger & Son, Chico, $48,923; . M. Carr, Santa Rosa, $47,201; Harry J. ser & Peter Sorenson, Redwood City, $49,-9; M. E. Whitney, Bakersfield, $49,920; ouis Biasotti & Son, Stockton, $50,146; J. P. rennan, Redding, $51,257. Contract varded to M. A. Jenkins, Sacramento, 3,926.

CALAVERAS COUNTY—Between San aquin Co. line and San Andreas, portions ly, about 6.5 miles in length, to be repaired placing untreated rock base and recontioned by the road mixed method. District , Route 24, Sections A,B. Marshall S. Hanhan, Redwood City, $59,570; Ted Watkins, nden, $60,364; Louis Biasotti & Son, ockton, $68,810; Claude C. Wood, Lodi, 9,980. Contract awarded to George French, ., Stockton, $47,778.

COLUSA COUNTY—Between Yolo ounty line and four miles south of Williams, rtions only, about 9.7 miles to be repaired th plant-mixed material. District III, oute 7, Sections A,B. Hemstreet and Bell, arysville, $60,475; McGillivray Construcon Co., Sacramento, $61,445; J. A. Casson ., Hayward, $62,430; Marshall S. Hanran, Redwood City, $69,735; A. Teichert & ., Sacramento, $72,022. Contract awarded Clements & Co., Hayward, $55,750.

CONTRA COSTA COUNTY—Between uir Station and Christie Underpass, about miles to be repaired with crusher run base d plant-mixed material. District IV, Route 6, Section A. Lee J. Immel, Berkeley, 6,286; A. J. Raisch, San Jose, $77,321; C. Smith, San Mateo, $78,225. Contract arded to Piazza & Huntley, San Jose, 6,642.

CONTRA COSTA COUNTY—Between miles east of Orinda Junction and 0.1 mile est of Walnut Creek, about 4.7 miles to be rfaced with plant mixed surfacing. District , Route 75, Section A. Piazza & Hunt-, San Jose, $71,543; A. G. Raisch, San ancisco, $73,170; Chas. L. Harney, San ancisco, $74,585; Lee J. Immel, Berkeley, 7,205; Parish Bros., Sacramento, $77,945; anite Construction Co., Watsonville, $83,-3. Contract awarded to Union Paving Co., n Francisco, $65,775.

CONTRA COSTA COUNTY—Between alnut Creek and one mile north of Danle, about 5 miles to be repaired with crusher n base and plant mixed material. District , Route 107, Section A. Union Paving Co., n Francisco, $76,775; Piazza & Huntley, n Jose, $78,146; J. A. Casson Co., Hayrd, $78,845; A. J. Raisch, San Jose, $83,-3; L. C. Smith, San Mateo, $88,749. Conact awarded to Lee J. Immel, Berkeley, 5,972.

CONTRA COSTA COUNTY—In the City Richmond, on the west side of 14th Street tween Shipyard and Cutting Blvd., a disnce of about 0.4 mile, sidewalk areas to be aded; imported borrow to be placed and rtland cement concrete sidewalks to be conucted. District IV. Contract awarded to e J. Immel, Berkeley, $3,381.

CONTRA COSTA COUNTY—Between Concord and 2.25 miles west, between Byron Junction and 1.5 miles west and between Old River and 1.8 miles west, about 5.6 miles to be repaired with plant mixed material and a Class "C-Medium" seal coat. District IV, Route 75, Sections B,D. Piazza and Huntley, San Jose, $46,024; Louis Biasotti & Son, Stockton, $53,476. Contract awarded to Lee J. Immel, Berkeley, $44,815.

HUMBOLDT COUNTY—Between Arcata and Clam Beach, about 5 miles to be repaired with plant mixed material and a seal coat. District I, Route 1, Section I. Clements & Co., Hayward, $44,332; Marshall S. Hanrahan, Redwood City, $46,980. Contract awarded to Mercer Fraser Co., Eureka, $41,530.

HUMBOLDT COUNTY—Portions between Trinidad and Little Red Hen, about 9.0 miles to be repaired with imported base material and armor coat. District I, Route 1, Section J. Mercer Fraser Co., Eureka, $151,-537. Contract awarded to Marshall S. Hanrahan, Redwood City, $147,290.

IMPERIAL COUNTY—Between Trifolium Canal and 2 miles north of Sandy Beach Road, about 11.7 miles to be repaired by the road mix method. District XI, Route 26, Sections B,C. Contract awarded to R. E. Hazard & Sons Construction Co., San Diego, $58,794.

IMPERIAL COUNTY—Across the Colorado River at Yuma, the existing bridge deck to be reconstructed. District XI, Route 27, Section B. H. L. Royden, Phoenix, Arizona, $26,166; Carlo Bongiovanni, Hollywood, $33,-795; Ralph A. Bell, San Marino, $43,163. Contract awarded to Fred D. Kyle, Los Angeles, $21,947.

KERN COUNTY—About 39 miles east of Route 4 junction, a reinforced concrete slab bridge across Poso Creek to be constructed. District VI, Route 142, Section D. C. B. Tuttle, Wilmington, $21,203; Dan Caputo, San Jose, $22,765; James B. Allen, San Carlos, $22,992; M. E. Whitney, Bakersfield, $23,-875; Robert R. Hensler, North Hollywood, $23,995; Rand Construction Co., Bakersfield, $24,630; Trewhitt, Shields & Fisher, Fresno, $25,120; Ralph A. Bell, San Marino, $26,575; James H. McFarland, San Francisco, $26,-978; Fred D. Kyle, Los Angeles, $32,208. Contract awarded to F. Fredenburg, South San Francisco, $20,260.

MENDOCINO AND HUMBOLDT COUNTIES—At various locations between Riverview Ranch and 1.4 miles north of Pepperwood, about 8.1 miles to be repaired with armor and seal coats, and screenings to be furnished. District I, Route 1, Sections K, AD. Clements & Co., Hayward, $26,400; E. A. Forde, San Anselmo, $26,485. Contract awarded to Close Building Supply, Hayward, $26,011.

MONTEREY COUNTY—Between East Garrison and Route 117, about 4.7 miles to be graded and surfaced with armor coat on a crusher run base. District V, Hilltown Road. M. J. Ruddy & Son, Modesto, $115,551. Contract awarded to Granite Construction Co., Watsonville, $102,236.

PLACER AND YUBA COUNTIES—Portions between Lincoln and Wheatland, about 6.5 miles to be repaired with plant mixed material. District III, Route 3, Sections B,A. Contract awarded to A. Teichert & Co., Sacramento, $45,844.

LOS ANGELES COUNTY—Between Los Angeles city limits and Ventura County line, portions only, a net length of about 4.4 miles to be repaired with plant mixed material. District VII, Route 60, Sections A,B. Southwest Paving Co., Roscoe, $38,529; Griffith Co., Los Angeles, $41,710; Oswald Bros., Los Angeles, $43,170. Contract awarded to Schroeder & Co., Inc., Roscoe, $34,785.

LOS ANGELES COUNTY—The completion of a partially finished contract for construction of a portion of State highway between Macy Street and Indiana Street, portions of bridge and approaches to be constructed. District VII, Route 26, Sections LA,D. Southwest Paving Co., Roscoe, $133,-997; Vido Kovacevich, Southgate, $141,236; Griffith Co., Los Angeles, $158,223; United Concrete Pipe Corp., Los Angeles, $168,[illegible]. Contract awarded to J. E. Haddock, Ltd., Pasadena, $130,781.

LOS ANGELES COUNTY—Across Los Angeles River and tracks of S. P. R. R. and Los Angeles Ry. at Figueroa Street in Los Angeles. District VII, Route 165. United Concrete Pipe Corp., Los Angeles, $120,697; Oberg Bros., Inglewood, $121,021; Griffith Co., Los Angeles, $126,804; W. J. Distelli, Los Angeles, $132,852; Contracting Engineers Co., Los Angeles, $142,777; Carlo Bongiovanni, Hollywood, $146,463; Ralph A. Bell, San Marino, $156,307. Contract awarded to A. S. Vinnell Co. & Engineers, Ltd., Alhambra, $120,568.

MENDOCINO COUNTY—Between 0.4 mile south of Wilson Creek and Sapp Creek, about 2 miles to be repaired with imported base material and armor coat. District I, Route 1, Section H. Contract awarded to Close Building Supply, Hayward, $34,372.

MARIN AND SONOMA COUNTIES—Between Ignacio and Sears Point, about 7.2 miles, existing roadbed to be widened with imported borrow and plant mixed surfacing to be placed. District IV, Route 8, Section A,A. Parish Bros., Sacramento, $95,756; Lee J. Immel, Berkeley, $111,801; Chas. L. Harney, San Francisco, $125,725; Fredrickson & Watson Construction Co., Fredrickson Bros., Oakland, $129,733. Contract awarded to A. G. Raisch, San Francisco, $93,688.

NEVADA COUNTY—Portions between Truckee and Nevada State line, about 1.1 miles to be repaired with plant mixed material. District III, Route 38, Sections A,B. A. Teichert & Co., Sacramento, $10,460. Contract awarded to Hemstreet & Bell, Marysville, $7,840.

RIVERSIDE COUNTY—Between Corona and Riverside, about 4 miles to be repaired by placing plant mixed surfacing over the existing bituminous surface. District VIII, Route 43, Section B. Vido Kovacevich, South Gate, $20,915; E. L. Yeager, Riverside, $22,937; M. W. Stanfield Co., Los Angeles, $23,170; Oswald Bros., Los Angeles, $23,728. Contract awarded to George Herz & Co., San Bernardino, $17,465.

SAN DIEGO COUNTY—Between Leucadia and Orange County line and between 4.8 miles southeast of Vista and San Luis Rey River Bridge, portions only, a net length of about 15.9 miles to be repaired with plant mixed material. District XI, Routes 2 and 77, Sections B, Ocn, C, D; C,D. Lewis Construction Co., Los Angeles, $108,676; G. W. Ellis, North Hollywood, $117,795; Pacific Rock & Gravel, Los Angeles, $124,880. Contract awarded to Southwest Paving Co., Roscoe, $104,643.

SAN JOAQUIN COUNTY—Between Terminous and Mosely Road, about 5.0 miles to be repaired by grading and placing a seal coat on crusher run base. District X, Route 53, Section C. W. C. Railing, Redwood City, $69,762; Elmer J. Warner, Stockton, $73,-300; J. A. Casson Co., Hayward, $60,170; E. A. Forde, San Anselmo, $72,200; Claude C. Wood, Lodi, $59,287; Lee J. Immel, Berkeley, $68,550; A. Teichert & Co., Sacramento, $73,170; Sierra Trucking Co., Inc., Reno, $73,305; Close Building Supply, Hayward, $74,380. Contract awarded to Louis Biasotti & Son, Stockton, $58,635.

SANTA BARBARA COUNTY—Between Castillo Street and Leadbetter Road in city of Santa Barbara, about 0.6 mile in length to be graded and paved with plant-mixed surfacing on crusher run base. District V. Basich Bros. Construction Co., Torrance, $53,198; L. A. Brisco, Arroyo Grande, $55,887; Brown, Doko & Baum, Pismo Beach, $57,662. Contract awarded to Fredrickson & Watson Construction Co., Fredrickson Bros., Oakland, $41,763.

SANTA BARBARA COUNTY—Between Cebada Canyon and Buellton, about 13.6 miles to be graded and surfaced with plant-mixed surfacing. District V, Route 149, Section B,C. Calowell Construction Co., Long Beach, $345,624; Fredrickson & Watson Construction Co., Fredrickson Bros., Oakland, $377,736; W. E. Hall Co., Alhambra, $378,150. Contract awarded to Griffith Co., Los Angeles, $302,948.

SANTA BARBARA COUNTY—Across Branch and Salisbury Canyons about 24 miles west of Maricopa, two bridges to be constructed. District V, Route 57, Section D. [illegible] Systems, Inc., Los Angeles, $18,937; M. F. Whitney, Bakersfield, $19,322; [illegible] Construction Co., Los Angeles, $20,216; Trewhitt, Shields & Fisher, Fresno, $20,501; C. B. Tuttle, Wilmington, $20,962; Don Cipes, San Jose, $22,496. Contract awarded to Wm. F. Thomas Concrete Construction, Sacramento, $17,406.

SANTA CLARA COUNTY—Between 3.4 miles east of Bells Station and Merced County line, about 2.8 miles to be repaired with crusher run base and armor coat. District IV, Route 32, Section C. Pacific Truck Service, Inc., San Jose, $24,112; W. C. Railing, Redwood City, $25,168. Contract awarded to Granite Construction Co., Watsonville, $23,855.

SHASTA AND SISKIYOU COUNTIES—Between Lamoine and Hat Road, about 28.3 miles in length to be repaired with plant-mixed material. District II, Route 3, Section D,A,Dnr,M,Sha,B,C. Contract awarded to Conwell & Co., Hayward, $135,470.

SOLANO COUNTY—Between East City limits of Vacaville and Yolo County line, portions only, a net length about 10.8 miles to be repaired with plant-mixed material. District X, Route 7, Sections D,E. J. A. Casson Co., Hayward, $88,523; Phoenix Construction Co., Bakersfield, $88,747; A. Teichert & Co., Sacramento, $104,110; Louis Biasotti & Son, Stockton, $111,173. Contract awarded to McGillivray Construction Co., Sacramento, $86,878.

TEHAMA COUNTY—Reinforced concrete slab bridge to be constructed across South Fork of Dibble Creek about 3 miles west of Red Bluff. District II, Route 29, Section E. Jame H. McFarland, San Francisco, $4,962; Wm. F. Thomas Concrete Construction, Sacramento, $5,576; M. A. Jenkins, Sacramento, $5,762; Carlton C. Gildersleeve, Williams, $6,974; J. P. Brennan, Redding, $6,983; Olsen Bros., Red Bluff, $7,221; Yancey Company, Sacramento, $11,081. Contract awarded to Jack Gilmore, Redding, $4,867.

VENTURA COUNTY—Route 60 between El Rio and Oxnard and Route 2 between North [illegible] of Ventura and Santa Barbara County line, portions [illegible] to be repaired with plant-mixed [illegible]. District VII, Routes 60,2, Sections B,D,E,F,G. R. M. Price, Huntington Park, $60,[illegible]; [illegible], Los Angeles, $66,821; [illegible], $68,405; Oswald Bros., Los Angeles, $72,670; Basich Bros. [illegible], Torrance, $76,950. Contract awarded to C. W. [illegible], North Hollywood, $60,[illegible].

KINGS COUNTY—Between Hanford and [illegible] [illegible] miles [illegible] District VI, Route [illegible] [illegible], M. [illegible] $[illegible]; Phoenix Construction [illegible] $[illegible] [illegible] $[illegible]

[illegible] Co., Compton, $89,790. Contract awarded to Warren Southwest, Inc., Los Angeles, $70,407.

EL DORADO COUNTY—Between Clarksville and Shingle Springs, about 5.2 miles to be repaired with plant-mixed material. District III, Route 11, Section A. A. Teichert & Company, Sacramento, $34,158. Contract awarded to McGillivray Construction Co., Sacramento, $33,846.

ALAMEDA COUNTY—Between Mountain House and Greenville, about 5.4 miles to be repaired with plant-mixed material. District IV, Route 5, Section E. Louis Biasotti & Son, Stockton, $47,305; J. A. Casson Co., Hayward, $47,690; Lee J. Immel, Berkeley, $48,410; Union Paving Co., San Francisco, $49,790; L. C. Smith, San Mateo, $53,981; Parish Bros., Sacramento, $57,680; Chas. L. Harney, San Francisco, $58,430; Marshall S. Hanrahan, Redwood City, $66,470. Contract awarded to A. J. Raisch, San Jose, $41,054.

CONTRA COSTA COUNTY—Between northerly city limits of Richmond and Carquinez Bridge, portions only, about 9.7 miles to be repaired with asphalt concrete. District IV, Route 14, Sections A,Pin,Her,B. Louis Biasotti & Son, Stockton, $167,849; Lee J. Immel, Berkeley, $168,744; Piazza & Huntley, San Jose, $176,640; Parish Bros., Sacramento, $179,709; Union Paving Co., San Francisco, $188,629; Chas. L. Harney, San Francisco, $191,126. Contract awarded to A. J. Raisch, San Jose, $151,093.

FRESNO COUNTY—Between Merced County line and Firebaugh, portions about 7 miles in length to be repaired by the road-mix method and applying a seal coat. District VI, Route 41, Section M. A. Teichert & Co., Sacramento, $46,700; Phoenix Construction Co., Bakersfield, $50,265; Owl Truck and Construction Co., Compton, $53,190. Contract awarded to M. W. Stanfield Co., Los Angeles, $45,368.

KERN COUNTY—Between 6.6 miles northwesterly and 1 miles easterly of Mojave, portions about 8.2 miles in length to be repaired by the road mix method. District IX, Routes 23,58, Sections B,A,G. Basich Bros. Construction Co., Alhambra, $13,502; Oswald Bros., Los Angeles, $16,487; Arthur A. Johnson, Laguna Beach, $16,547; A. S. Vinnell Co., Alhambra, $17,623; Roland T. Reynolds, Anaheim, $21,731; Holman & Powell Paving Co., Los Angeles, $23,262. Contract awarded to Phoenix Construction Co., Bakersfield, $12,367.

LOS ANGELES COUNTY—Route 4 between Castaic Creek and Los Alamos Creek and Route 23 between Harold and Palmdale, portions only, a net length of about 9.8 miles to be resurfaced with plant-mixed surfacing. District VII, Route 4,23, Sections A,H,I & E. Southwest Paving Co., Roscoe, $95,433; Vido Kovacevich, South Gate, $99,848; R. J. Burton, Los Angeles, $101,192; Basich Bros. Construction Co., Torrance, $102,750; Oswald Bros., Los Angeles, $112,010; Griffith Co., Los Angeles, $115,016; Pacific Rock & Gravel Co., Los Angeles, $126,230; Lewis Construction Co., Los Angeles, $129,118. Contract awarded to Schroeder & Co., Inc., Roscoe, $91,247.

SAN DIEGO COUNTY—Between Oceanside and El Moreno, about 23 miles to be [illegible], portions to be surfaced with plant-mixed surfacing, bituminous surface treatment to be applied to other portions, and a reinforced concrete bridge to be widened. District XI, Routes 2,77, Section Oc,[illegible] A,D. Basich Bros. Construction Co., Torrance, $127,567; Owl Truck & Construction Co., Compton, $129,615; Griffith Co., Los Angeles, $163,337; Calowell Construction Co., Long Beach, $175,660; Dennis Industrial Corp., Wilmington, $190,000; Rhoads Bros. & Shofner, Los Angeles, $2[illegible]; W. R. Dennis Construction Co., San [illegible], $231,316; Basich & Basich Contractors, Inc., Los Angeles, $240,244. Contract awarded to J. E. Haddock, Ltd., Pasadena, $127,251.

MONO COUNTY—Between McGee Creek and Crestview, portions, about 6 miles in length, to be repaired by placing road-mix surfacing over the existing bituminous surface. District IX, Route 23, Sections D,[illegible]. Phoenix Construction Co., Bakersfield, $10,663; R. R. Hensler, North Hollywood, $12,924. Contract awarded to Basich Bros., Torrance, $9,817.

KERN COUNTY—Between 13.5 miles south of Bakersfield and Famoso, about 16 miles of plant-mix surfacing to be placed. District VI, Route 4, Sections C,G,E. Union Paving Co., San Francisco, $111,204; Phoenix Construction Co., Bakersfield, $122,380; Basich Bros., Los Angeles, $124,282; J. E. Haddock, Ltd., Pasadena, $139,462; Brown, Doko & Baum, Pismo Beach, $139,739. Contract awarded to Griffith Co., Los Angeles, $104,38[illegible].

SAN MATEO COUNTY—On Industrial Way in South San Francisco, about 0.7 mile to be graded and surfaced with plant-mixed surfacing on crusher run base. District IV. L. C. Smith, San Mateo, $35,569; Chas. L. Harney, San Francisco, $36,707; Peter Sorenson, Redwood City, $40,879. Contract awarded to Union Paving Co., San Francisco, $32,331.

MONTEREY COUNTY—Portions between southerly boundary and King City, about 3.9 miles of plant-mixed surfacing to be placed. District V, Route 2, Sections I,H,G,F. Brown, Doko and Baum, Pismo Beach, $28,340; A. J. Raisch, San Jose, $33,550; L. A. Brisco, Arroyo Grande, $35,193. Contract awarded to Granite Construction Co., Watsonville, $26,061.

ORANGE COUNTY—Between Galivan and Irvine, portions only, a net length of about 3.2 miles to be resurfaced with plant-mixed surfacing. District VII, Route 2, Section E. Pacific Rock & Gravel Co., Los Angeles, $27,673; Vido Kovacevich, South Gate, $29,389. Contract awarded to Sully-Miller Contracting Co., Long Beach, $22,555.

SANTA BARBARA AND SAN LUIS OBISPO COUNTIES—Between Santa Ynez River and San Luis Obispo, portions about 8.7 miles in length, plant-mixed surfacing to be placed. District V, Route 2, Sections D,C,B,F,E. L. A. Brisco, Arroyo Grande, $53,828. Contract awarded to Brown, Doko and Baum, Pismo Beach, $52,495.

TULARE COUNTY—At various locations totaling about 20.4 miles, plant-mixed surfacing to be placed. District VI, Routes 4, 10,133, Sections AF, B, A, Visalia. Griffith Co., Los Angeles, $146,798; Warren Southwest, Inc., Los Angeles, $151,358; George French, Jr., Stockton, $154,047; A. J. Raisch, San Jose, $156,479; Brown, Doko and Baum, Pismo Beach, $160,511; Basich Brothers, Torrance, $162,012; Pacific Rock and Gravel Co. & M. W. Stanfield Co., Los Angeles, $165,876; A. Teichert & Co., Sacramento, $174,492; A. S. Vinnell Co., Alhambra, $177,095; J. E. Haddock, Ltd., Pasadena, $189,536; W. E. Hall Company, Alhambra, $207,282. Contract awarded to Piazza and Huntley, San Jose, $146,120.

SONOMA COUNTY—On Vallejo and Fresno Avenues, near Santa Rosa, about 0.9 mile to be graded and surfaced with plant-mixed surfacing on a crusher run base. District IV. Lee J. Immel, Berkeley, $45,520; A. G. Raisch, San Francisco, $46,513; Heafey-Moore Co., Oakland, $48,112. Contract awarded to C. M. Syar, Vallejo, $36,820.

MONTEREY COUNTY—Between Seaside Junction and North Reservation Boundary, about 4.7 miles to be graded and surfaced with armor coat on crusher run base. District V, Route 56, Section I. Granite Construction Co., Watsonville, $134,376; L. C. Karstedt, Watsonville, $153,507. Contract awarded to M. J. Ruddy & Son, Modesto, $119,487.

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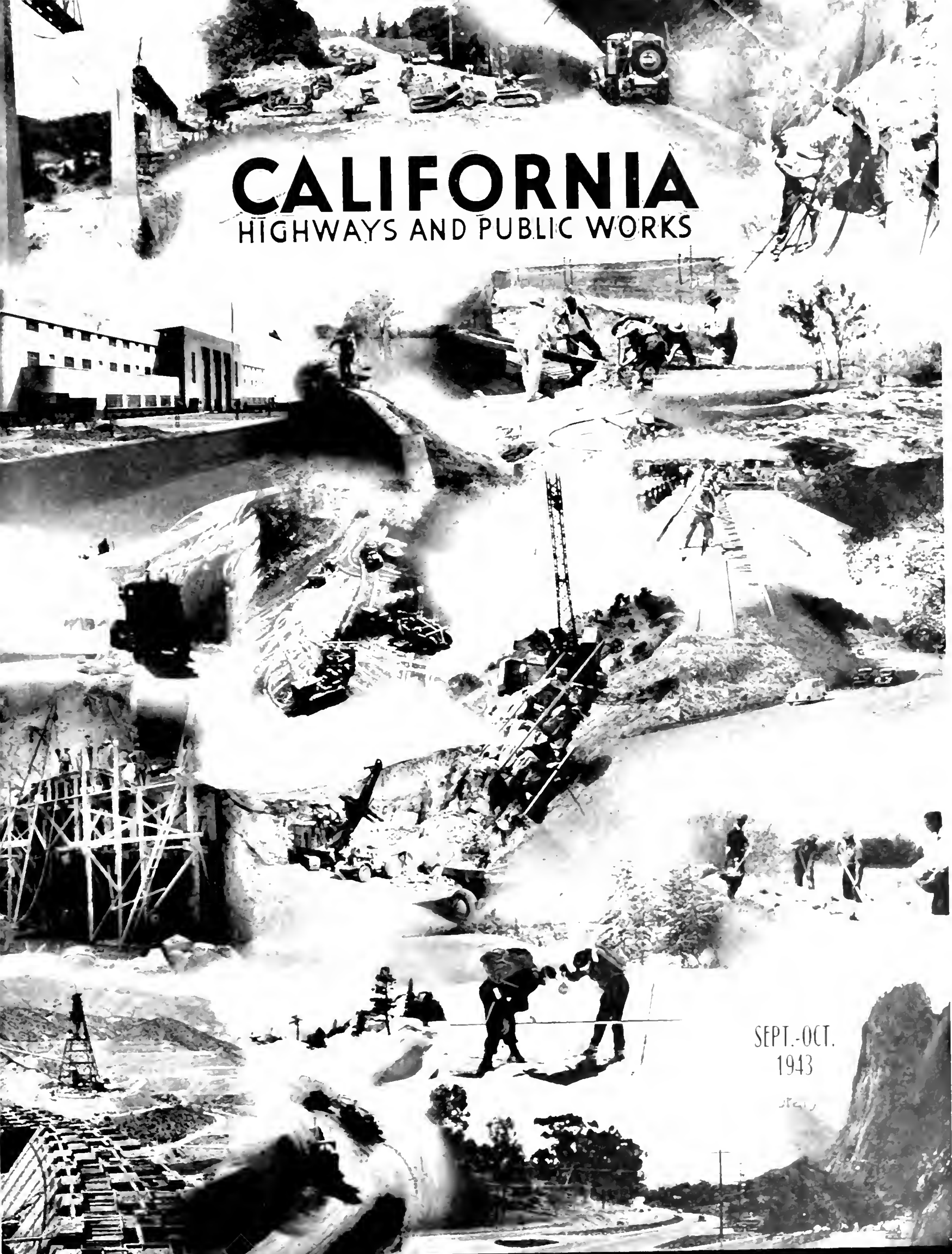

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CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California [PRINTED IN U. S. A.]

C. H. PURCELL, Director GEORGE T. McCOY, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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$87,829,500 Provided by Legislature for Postwar Reemployment, Reconstruction and Readjustment

PLANNING for postwar highway construction by the Department of Public Works will be closely nked with the program of Governor arl Warren's Reconstruction and Re-nployment Commission. This is in ccord with the expressed wishes of the overnor who believes that postwar rosperity of a State as large as Cali-ornia will depend upon a scientific sys-em of highways and that such a sys-em, in turn, will depend upon greater ision in planning future highways.

With a huge postwar public works rogram in the making, the Division f Highways and the California High-ay Commission will coordinate their lanning policies with those of the econstruction and Reemployment ommission and other State agencies the end that road rehabilitation and ew highway construction will go hand hand with State building, expansion f industries, development of Califor-ia's natural resources and the crea-on of future markets and new oppor-unities for capital with consequent enefits to labor and the forestalling of rge scale unemployment.

PRELIMINARY ENGINEERING STARTED

Preliminary surveys and prepara-on of plans, specifications and esti-ates of costs for proposed highway rojects to be built during the postwar eriod are rapidly becoming a major hase of the work of the Division of ighways.

During the months of July and ugust, advance engineering work nounting to $281,500 was authorized nd the preliminary engineering to be nanced with these funds was started. he money for this advance engineer-g consists of Federal funds from ppropriations under the National De-ense Highway Act of 1941 matched qually with State highway moneys. he total apportionment of the Fed-ral Advance Engineering funds to alifornia was $398,990.

At its first meeting on September 4th, the new Highway Commission transferred into the State Highway Budget Fund $12,000,000 appropriated by the Legislature for highway plans and surveys and the acquisition of rights-of-way for postwar construction. The commission allocated $3,000,000 of the amount to engineering surveys and $9,000,000 for right-of-way. This money is now available.

CONTRACT SIGNED WITH UNITED STATES

Endorsement of a proposal by Governor Warren that California enter into an agreement with the United States Government to cooperate with the War Department in preparing plans and specifications for postwar development of the State Water Plan was voted by the California Water Project Authority on August 31st. The Central Valley Project, now approaching completion, is a unit of the State Water Plan. A contract signed by Director of Public Works C. H. Purcell has been sent to Washington.

Congressional approval of plans which the United States Engineers propose to assemble should result in the expenditure in California of many millions of dollars for postwar construction of flood control, water storage and irrigation projects by Federal agencies, according to Director Purcell.

The State Water Plan, representing 20 years of study by the Division of Water Resources, contemplates 24 major water storage reservoirs and major conveyance canals for the Sacramento and San Joaquin River basins and irrigation for 10,000,000 acres of Central Valley lands.

STATE ASSISTANCE REQUESTED

The United States Engineers requested State assistance from Governor Warren in preparing plans for postwar construction over a period of years. Director Purcell said that under the agreement between the Federal Government and the Department of Public Works, State Engineer Edward Hyatt, and the Division of Water Resources, of which he is the head, will cooperate to the fullest extent with the United States Engineers.

Governor Warren believes that the Government plans will fit into his own postwar planning program.

Coordination of highway construction planning and the aims and purposes of the Reconstruction and Reemployment Commission is imposed upon Mr. Purcell who has a triple responsibility in that he is Director of the Department of Public Works, chairman of the Highway Commission and chairman of the Reconstruction and Reemployment Commission.

Work Should Be Done By Private Contractors Says Paul G. Hoffman

TOO much unemployment for too long is a direct invitation to dictatorship. Perhaps what has not been recognized so clearly is that if government furnishes too much employment for too long, the result will be similar. Regimentation will replace free enterprise, and pressures created by either too much unemployment or too much government spells death to a free country.

There is, of course, an obvious need for a postwar public works program, and there is no conflict whatsoever between planning for such a program and postwar planning by private industry. But if a public works program is to make its maximum contribution toward postwar readjustment of the economy as a whole, it is vital that its implementation provide for the use of private contractors.

Paul G. Hoffman,
President, the Studebaker Corporation, and Chairman, The Committee for Economic Development

Public works construction is a continuing function of government. In the opinion of Governor Warren and Purcell, plan preparation also should be a continuing function of Federal, State and local governments to guard against wasteful expenditure of public funds in the postwar period.

LEGISLATURE PROVIDES FUNDS

To supplement the recovery efforts of private business it will be necessary to advance to the contract-letting stage thousands of Federal, State and local projects. This will be achieved in California thanks to the farsightedness of the Legislature which appropriated a total of $14,750,000 to finance plans for State and county highway construction after the war and for preliminary work necessary for a program of reconstruction, rehabilitation and replacement of State-owned buildings, colleges and schools.

Legislative appropriations to aid postwar readjustments aggregate $87,829,500. They are:

$43,750,000 (estimated) to make up the "Postwar Employment Reserve" provided for by Chapter 572 and designed to meet the needs of the State for construction and rehabilitation of buildings and facilities and to provide postwar employment. Appropriates $1,250,000 from this reserve for surveys, preparation of plans and specifications and other preliminary work necessary for a program of reconstruction, rehabilitation and replacement of State-owned buildings, colleges and schools.

$12,000,000 appropriated by Chapter 564 to the Department of Public Works for the preparation of surveys, plans, and specifications and the acquisition of rights-of-way for State highway postwar construction projects.

$1,500,000 appropriated by Chapter 565 to be allocated among the counties for the preparation of plans, surveys and specifications for postwar county highway construction projects.

$30,000,000 bond issue (subject to approval by the voters in the next general election) provided for by Chapter 585 and which funds would be used for purchase of farms and homes for veterans of World War II. Pending the approval of this bond issue $2,000,000 is appropriated for present use. This amount is to be returned to the State Treasury when bond money becomes available.

$300,000 appropriated by Chapter 627 to the Veterans Welfare Board for educational assistance to veterans of World War II.

$150,000 appropriated by Chapter 1058 to the Veterans Welfare Board to assist veterans to prosecute claims against the Government arising out of war service and to establish rights to privileges or compensation.

$7,500 appropriated by H. R. 190 for use by the Assembly Interim Committee on Postwar Rehabilitation (Knight, T. Fenton, Chairman; Weber, Guthrie, Thompson, and Johnson) to make or cause to be made studies of agriculture, industry, natural resources, labor supply, population changes and other social factors for the purpose of formulating a program to absorb and assimilate into private enterprise men and women discharged from armed services or released from war industries.

$15,000 appropriated by S. R. 125 for use by the Senate Interim Committee on Postwar Construction (Mayo, Luckey, Mixter, Swing, Engle, Keating, Brown, Breed, and Tenney) to investigate and determine a construction program which will provide employment following the war.

$7,000 appropriated to the Joint Legislative Interim Fact-Finding Committee on Agricultural and Industrial Employment and Economic Planning (Hatfield, Chairman; Crittenden, Bashore, Hastain, and Lowrey) to study, analyze and report on a program for complete utilization of the agricultural and industrial capacities of the State and for efficient planning by labor, capital, and government for the war effort and for later peacetime adjustment.

$100,000 appropriated by Chapter 631 for use of State Reconstruction and Reemployment Commission.

One of the principal objectives of the Reconstruction and Reemployment Commission is to prepare jobs for men and women returning from the armed forces and to reestablish in civil pursuits some 500,000 or more war workers who have come into California.

"Preparation for peace is as important as preparation for justifiable war," Governor Warren said in discussing the work of the commission. "The kinds of readjustment and development in California immediately after the war will vitally affect the State's future.

"In greater or less degree, the commission will deal with three types of problems—assisting the people of our State in making a satisfactory living; aiding and improving conditions for living through encouraging construction of more and better physical facilities and services; and fostering improvements in health, education, human welfare, and the attainment of a better life.

"Basic goals for economic readjustment are: One, maintaining a high level of employment. Two, maintaining as far as possible California's favorable income level for its larger population. Achieving these objectives requires expanding the State's peacetime production in agriculture, mining, forestry, fisheries and manufacturing, together with a concomitant increase in trade and services.

"We must determine as far as possible the probable magnitude and rate of discharge of war workers and demobilization of the armed forces and the number of peacetime jobs which will be required in various fields both for the State as a whole and for the major industrial areas. Such information will provide the basis for determining critical periods when public works, construction and other aids to reemployment would be most effective."

Gen. Fleming Advocates a National Plan for Public Works Program

MEASURED against the potential need, very little has been done in the way of actual preparation of plans and specifications and the securing of sites by governmental units for postwar construction.

Taking the Federal Government first, it is estimated that the amount of construction that could be put under way on short notice adds up to only about $600,000,000.

When we turn to the States, the outlook isn't much more encouraging. Coming to the cities and other local units of government, we find the page almost blank.

What I personally hope to see is some kind of over-all National plan of public works construction which will be capable of management in such a way that it will best supplement the recovery efforts of private business. I think it should consist of Federal, State and local projects, the most urgently needed of which will be advanced to the contract-letting stage before the war ends. Unless we have such a National program, we run the risk of seeing any public works program surrendered to various group and community pressures.

Maj. Gen. Philip B. Fleming,
Administrator, Federal Works Agency, Washington, D. C.

New Highway Commission Sworn Into Office; Holds First Meeting

tate Highway Commission—Chester H. Warlow, Fresno; F. Walter Sandelin, Ukiah; Harrison R. Baker, Pasadena; Charles H. Purcell, Chairman; James A. Guthrie, San Bernardino; C. Arnholt Smith, San Diego; Homer P. Brown, Placerville

A NEW era in California highway building was inaugurated on September 11th when the members of Governor Warren's recently appointed highway commission were formally sworn into office, received their commissions and at their first official meeting heard Chairman C. H. Purcell state that California plans to embark upon a postwar highway construction program to total approximately one hundred million dollars.

The new appointees gathered in the Governor's council chamber at the Capitol at 10.30 a.m. and after drawing lots for long and short staggered terms of office were addressed by Governor Warren, who impressed upon them the wide and important scope of their new duties, dwelling at some length upon the beneficial effect of an adequate highway program upon the economic welfare and prosperity of the State and all its citizens.

Governor Warren told the commissioners the postwar prosperity of a State as large and complex as California will depend upon a "scientific system of highways" and this, in turn, will depend upon greater vision than merely planning and building on the basis of local interests.

"I am proud of the personnel of this commission," said the Governor, "because I believe it will constitute a highway commission of the whole State in the truest sense of the word. In your chairman, State Public Works Director Purcell, you have one of the greatest highway engineers in the country."

It is important, the Governor said, for the highway commission to tie in all its planning with that of other State agencies, devising policies for postwar building, expansion of industries, and development of natural resources.

"We are going into the planning business very seriously in California," said Governor Warren. "California has a tremendous job to do. There may be an upsurge in our State after the war outdoing the famous gold rush days. But if we don't plan intelligently we may lose a lot of new industry which has come to us in wartime, and we must remember more than 1,000,000 civilian workers have come

(Continued on page 6)

Members of the New California State Highwa

JAMES A. GUTHRIE

JAMES A. GUTHRIE was born in San Bernardino in 1888 and has served for more than 35 years with the San Bernardino Daily Sun, of which he is editor and president.

Mr. Guthrie already is intimately acquainted with much of the highway development in southern California, and his newspaper had leadership in the original good roads program of San Bernardino County in advance of State highway construction. That program included important pioneer work on what are now highways U. S. 66, 91, 99, and the Rim of the World highway.

He is a member of advisory board, Automobile Club of Southern California, and a member of San Bernardino city traffic and safety commission.

He serves San Bernardino's community activity as a member of executive committees of war savings bond, war chest, USO and Red Cross. He is a member of board of directors of San Bernardino Chamber of Commerce and a member of mountain advisory board, San Bernardino County Chamber of Commerce. He is married and has two children, James K., of San Bernardino, and Kathleen, of Stanford University.

C. ARNHOLT SMITH

C. ARNHOLT SMITH of San Diego is one of the leading bankers of southern California and has been engaged in the banking business most of his life, having started as a bank messenger when a boy.

He is president of the Clearing House Association of San Diego, vice president and chairman of the board of the United States National Bank of San Diego, and president of the City Bank of Monrovia. He is also president of the National Iron Works of San Diego.

He was born in Oregon but moved to San Diego when still a youth. He lived in San Diego and attended the public schools in that city. He later lived in Los Angeles for several years. He is married and has two children, a boy and a girl.

He has always been interested in yachting and rowing. He has contested in many races, both crew and single shell contests. In 1920 at San Francisco he won the Pacific Coast single shell championship.

Commissioner Smith has always taken an active interest in highway matters and feels that he will be very happy in his new position as a highway commissioner.

HOMER P. BROWN

HOMER P. BROWN of Placerville is general manager of the Diamond Springs Lime Company located at Diamond Springs, El Dorado County, near Placerville. He is an active member of the El Dorado Chamber of Commerce, of which he is a director, and chairman of the Industries Committee of the Sacramento Valley Council of the California State Chamber of Commerce. Mr. Brown is also a director of the Mother Lode Highway Association.

He is a member of the Sutter Club of Sacramento and of the Bohemian Club of San Francisco.

He was born in Butte County July 4, 1878, and was engaged in the sugar industry for 21 years.

He went to El Dorado County about 1927 and built the plant of the Diamond Springs Lime Company which he owns and operates. That plant has been almost exclusively engaged in providing war materials for the United States Government since Pearl Harbor.

ommission Appointed by Governor Earl Warren

CHESTER H. WARLOW

CHESTER H. WARLOW of Fresno is a lawyer, banker, and oil company executive. He was born June 30, 1889, in Virginia, Cass County, Illinois, and has lived in California since December, 1889. He was educated in the Fresno public schools and is a graduate of Kemper Military School of Boonville, Missouri, 1906; Stanford University, A.B., 1911, J.D., 1913; and Harvard Law School, Cambridge, Massachusetts, 1911-12.

He was admitted to the bar in California, June 1913, and practiced in the office of his father, George L. Warlow, until the latter's decease, when he entered private practice in 1930.

He is Fresno trust officer of the Security First National Bank of Los Angeles; chairman of the Fresno County Crime Commission, and has been vice president and president of the Fresno County Chamber of Commerce and is now a member of the Roads and Resorts Committee of that organization. He is also a member of the San Joaquin Council of the State Chamber of Commerce and member of the executive committee of the local council serving on its committee of roads and highways.

(Continued on page 18)

F. WALTER SANDELIN

F. WALTER SANDELIN of Ukiah is a hotel proprietor, being owner and manager of the Palace Hotel in that city. He was born in San Francisco in 1897 and in addition to being a native son, enjoys the proud distinction of being the father of three children, two boys and a girl, all of whom are in Coast Guard service. He has been actively engaged in the hotel business all his life. His father, the late Frank Sandelin, was a hotel man in San Francisco and later in Ukiah.

Commissioner Sandelin is a veteran of World War I, having enlisted in the Naval Reserve, and was mustered out of service in 1918 when the war ended. He is a past president of Ukiah Rotary Club, past commander, American Legion Post, and past president, Ukiah Chamber of Commerce. His children are F. W., Jr., 23 years old, serving with Coast Guard in Alaskan waters; Robert, 20, Government Island Coast Guard Base in Alameda; and Irene Marie, 21, who is a SPAR.

Commissioner Sandelin is chairman of the transportation committee of the Redwood Empire Association, also vice president and director.

HARRISON R. BAKER

HARRISON R. BAKER, who is one of the best known real estate men of Pasadena, has taken an outstanding part in the upbuilding of the community and has been active for years in numerous civic, social and business organizations. For fourteen years he has been a member of the Pasadena Planning Commission, serving as vice chairman for several terms, and was recently elected chairman. He is the oldest member of that body in point of service, although in years, he is one of Pasadena's younger business men.

He was born in Los Angeles in 1894, the son of Charles M. and Helen B. Baker. His father was an early real estate developer in Los Angeles, and later manager of the Pasadena office of the Los Angeles Gas and Electric Company.

The Baker family moved to Pasadena when the subject of this sketch was only nine years old and here he graduated from high school, where he won his letter in track, being a sprinter in those days. He later attended Occidental College, where he was a baseball player. He was valedictorian of the

(Continued on page 6)

New Highway Commission Holds First Meeting

(Continued from page 3)

into California since the 1940 census.

"We must remember, too, our new steel, magnesium, aluminum and plastic industries because those are the things with which we will be working after the war is over. We have the natural resources and we can keep these industries if we prepare now for the future and don't let somebody beat us to the punch."

Governor Warren told the commission he believes the commission meetings should be held as a general rule in Sacramento where the headquarters of the Department of Public Works is located.

He asked Director Purcell about the status of highway conditions in California. Mr. Purcell replied that with 14,000 miles of State highways, more wartime tonnage in trucks is being carried in California than in any other State in the Nation. He added that if plans are mapped properly, California will be in position to start 50 per cent of her proposed new highway projects as soon as the war is over.

The new commissioners and the dates their terms will expire are:

Walter Sandelin, hotel man of Ukiah, Mendocino County; January 15, 1944.

Homer P. Brown, manufacturer of Placerville, El Dorado County; January 15, 1947.

Chester H. Warlow, banker and local highway organization leader of Fresno; January 15, 1945.

Harrison R. Baker, real estate man of Pasadena, Los Angeles County; January 15, 1946.

James Guthrie, newspaper publisher of San Bernardino; January 15, 1945.

C. Arnholt Smith, banker and manufacturer of San Diego; January 15, 1947.

After taking the oath of office administered by Deputy Secretary of State Hagerty and receiving their engrossed commissions signed in their presence by Governor Warren, the commissioners adjourned to the Department of Public Works building and were immediately called into session by Chairman Purcell and each presented with a large, bound compilation of maps and data.

On a rather lengthy agenda calling for votes on financial matters presented for their first consideration was a resolution to make available $12,000,000 appropriated by the last Legislature for surveys and plans and right-of-way acquisition for postwar highway construction projects. The commission voted to place that sum in the State Highway Fund budget and allocated $3,000,000 of the amount for surveys and plans and $9,000,000 for right-of-way on postwar projects that receive the approval of the commission.

In this connection, Commissioner Warlow of Fresno asked Chairman Purcell what the proposed postwar highway program would cost. Mr. Purcell replied it would approximate $100,000,000.

Other business on the agenda included highway maintenance and repair projects in various counties requiring allocations of funds in various amounts for acquisition of right-of-way, bank protection, repairing and reconstruction of bridges. It was voted to transfer $2,066,000 from the diesel-tax fund for posted bridges to the contingency reserve bridge reconstruction fund for financing the bridge projects.

$40 Per Capita Urged For Nation's Postwar Public Works Program

THERE is only one way we can guarantee that the proven principle of competitive bidding for public works programs, and the proven value of Federal-State highway financing, and the proven merit of civilian government operating civil public works, will be continued after the war. That way is to see that our cities and our States and our counties get together right away now to make advance preparations, in final detail, for a public works program involving $40 per capita for one year.

And the way to do it is to encourage democratic planning right at the grass roots level. No central agency in Washington can do the job and do it right. But if we fail, in our home towns, to be ready for the end of the war, I can tell you that some central agency in Washington will step in and try to do the job—and our citizens will accept the federalization, because it will be the logical and inevitable result of our local failure to be ready with useful public works.

G. Donald Kennedy,
Vice President, Automotive Safety Foundation; Chairman, Postwar Construction Committee, American Society of Civil Engineers

Harrison R. Baker

(Continued from page 5)

Class of 1917, and holder of a Phi Beta Kappa key. From Occidental he went to Harvard University Law School.

When the United States entered World War No. I, Mr. Baker entered the Navy and was commissioned an Ensign, later being promoted to Lieutenant (j. g.). He served as signal officer on the troop ship "Agamemnon," and made nine transatlantic voyages with soldiers for the American Expeditionary Force.

Following the war, he became associated with an investment company and in 1921 with Richard D. Davis, Jr., organized the realty firm known as the Davis-Baker Company which has developed many subdivisions in southern California and laid out a total of about 2,000 lots in the Pasadena section alone.

Mr. Baker is president of both the Davis-Baker Company, and the Davis-Baker Insurance Agency, Inc. In 1927 he was president of the Pasadena Realty Board, and for fifteen years has served as chairman of the Land Developers and Home Builders division of the California Real Estate Association. He is also one of the foremost real estate valuation experts in southern California.

He was one of the first to promote the construction of the Pasadena Arroyo Seco Parkway, and is credited with being one of the four men most responsible for this major improvement. In numerous other ways Mr. Baker has been influential in furthering community interests.

Mr. Baker is a member of the Pasadena Presbyterian Church and many other organizations, including the American Legion, University Club of Pasadena, and Phi Gamma Delta college fraternity. In 1923 he married Miss Grace E. McCormick, who was born in Iowa and came to Pasadena when 10 years old. They have one son, Harrison R. Baker, Jr., who is a Naval Reserve Cadet assigned for training to St. Thomas College, Minnesota, for an officers' training program.

Annual Highway Traffic Study Count Shows 30 Per Cent Drop Since 1941

By GEO. T. McCOY, State Highway Engineer

THE annual state-wide traffic count taken on Sunday and Monday, July 11th and 12th, shows a decrease of 15.1 per cent under the 1942 count. In comparison with 1941, this year's count shows a decrease of 30.0 per cent. The regularly occupied monthly key stations show that the percentage decrease under 1942 has remained fairly constant since April.

The decreases are found in every main group of routes and on practically all the 80 individual routes which form the basis for these comparisons. A further analysis of the routes that show an increase reveals that in almost all cases the increase is primarily due to additional truck traffic.

SUNDAY DROP LARGEST

It will be noted that, with few exceptions, all routes show a substantially larger decrease on Sunday than on Monday. The largest decrease is recorded on Sunday for the recreational group. The routes that comprise this group serve recreational areas, but the traffic which they carry is only partially concerned with recreation.

No change was made from the regular procedure of previous years in the manner of taking the count. Actual recording covers the 16-hour period from 6 a.m. to 10 p.m. for both Sunday and Monday. Traffic was segregated by hourly periods into the following vehicle classifications: California passenger cars, out-of-State passenger cars, buses, light trucks, heavy trucks, trailers drawn by trucks, trailer coaches, and other passenger car trailers.

Each year some minor changes in the census become necessary, such as the relocation, addition, or discontinuance of individual stations; but in every instance these are excluded when determining comparisons with the previous year, only those stations that were identical during both years being taken into consideration.

These comparisons for the various route groups are as follows:

PER CENT GAIN OR LOSS FOR 1943 COUNT AS COMPARED WITH 1942

	Sunday	Monday
All Routes	— 23.24	— 13.81
Main North and South Routes	— 25.30	— 16.35
Interstate Connections	— 21.21	— 9.81
Laterals Between Inland and Coast	— 19.23	— 10.14
Recreational Routes	— 29.46	— 15.72

The gain or loss of traffic volume for State Highway Routes 1 to 80 inclusive, which constitute the basis for the foregoing summary, is shown in the following tabulation:

		1943 Per cent gain or loss			
		Sunday		Monday	
Route	Termini	Gain	Loss	Gain	Loss
1.	Sausalito-Oregon Line		25.54		18.46
2.	Mexico Line-San Francisco		22.63		17.37
3.	Sacramento-Oregon Line		31.24		19.29
4.	Los Angeles-Sacramento		22.40		11.90
5.	Santa Cruz-Jc. Rt. 65 near Mokelumne Hill		27.13		13.63
6.	Napa-Sacramento via Winters		30.30		19.90
7.	Crockett-Red Bluff		33.49		27.35
8.	Ignacio-Cordelia via Napa		34.65		26.90
9.	Rt. 2 near Montalvo-San Bernardino		15.16		6.68
10.	Rt. 2 at San Lucas-Sequoia National Park		27.26		12.61
11.	Rt. 75 near Antioch-Nevada Line via Placerville		34.88		21.52
12.	San Diego-El Centro		25.99		20.32
13.	Rt. 4 at Salida-Rt. 23 at Sonora Jc.		34.60		21.23
14.	Albany-Martinez		30.84		29.15
15.	Rt. 1 near Calpella-Rt. 37 near Cisco		37.48		8.18
16.	Hopland-Lakeport		22.00		2.89
17.	Rt. 3 at Roseville-Rt. 15, Nevada City		26.81	11.00	
18.	Rt. 4 at Merced-Yosemite National Park		47.52		36.34
19.	Rt. 2 at Fullerton-Rt. 26 at Beaumont		3.76		1.80
20.	Rt. 1 near Arcata-Rt. 83 at Park Boundary		23.43		20.14
21.	Rt. 3 near Richvale-Rt. 29 near Chilcoot via Quincy		35.77		27.44
22.	Rt. 56, Castroville-Rt. 29 via Hollister		27.32		9.83
23.	Rt. 4 at Tunnel Sta.-Rt. 11, Alpine Jc.		36.01		19.15
24.	Rt. 4 near Lodi-Nevada State Line		31.09		15.25
25.	Rt. 37 at Colfax-Rt. 83 near Sattley		27.56		9.27
26.	Los Angeles-Mexico via San Bernardino		8.22		1.80
27	El Centro-Yuma		3.31	14.11	
28.	Redding-Nevada Line via Alturas		35.33		7.99
29.	Peanut-Nevada Line near Purdy's		37.12		37.45
31.	Colton-Nevada State Line		16.90		14.94
32.	Rt. 56, Watsonville-Rt. 4 near Califa		30.41		21.89
33.	Rt. 56 near Cambria-Rt. 4 near Famoso		24.94		12.55
34	Rt. 4 at Galt-Rt. 23 at Pickett's Jc		36.89		27.31
35.	Rt. 1 at Alton-Rt. 20 at Douglas City		34.16		18.03
37.	Auburn-Truckee		41.22		9.03
38.	Rt. 11 at Mays-Nevada Line via Truckee River		60.74		50.99
39	Rt 38 at Tahoe City-Nevada State Line		54.84		51.23
40.	Rt. 13 near Montezuma-Rt. 76 at Benton		56.92		54.78
41.	Rt 5 near Tracy-Kings River Canyon via Fresno		11.41	2.47	
42.	Redwood Park-Los Gatos		26.43		12.40
43.	Rt. 60 at Newport Beach-Rt. 31 near Victorville		19.26		6.43
44.	Boulder Creek-Redwood Park		17.38		20.92
45.	Rt 7, Willows-Rt. 3 near Biggs		20.94	12.77	
46.	Rt 1 near Klamath-Rt. 3 near Cray		22.31		13.04
47.	Rt. 7, Orland-Rt. 29 near Morgan		23.17		6.26
48.	Rt. 1 N of Cloverdale-Rt. 56 near Albion		38.40		26.83
49.	Napa-Rt 15 near Sweet Hollow Summit		25.79		4.02
50.	Sacramento-Rt. 15 near Wilbur Springs		3.02	10.22	
51.	Rt 8 at Schellville-Sebastopol		27.96		7.70
52.	Alto-Tiburon		7.29		6.59
53.	Rt. 7 at Fairfield-Rt 4 near Lodi via Rio Vista		3.73	8.16	
54	Rt. 11 at Perkins-Rt. 65 at Central House	6.33		17.81	
55.	Rt. 5 near Glenwood-San Francisco		37.87		28.91
56.	Rt 2 at Las Cruces-Rt. 1 near Fernbridge		23.24		10.30
57.	Rt. 2 near Santa Maria-Rt. 23 near Freeman via Bakersfield		19.96		20.82
58.	Rt. 2 near Santa Margarita-Arizona Line near Topock via Mojave and Barstow		3.54	12.60	
59.	Rt. 4 at Gorman-Rt. 43 at Lake Arrowhead		22.99		10.80
60.	Rt. 2 at Serra-Rt. 2 at El Rio		30.13		19.47
61.	Rt. 4 S. of Glendale-Rt. 59 near Phelan		21.73		6.95
62.	Rt. 171 at Northam-Rt. 61 near Crystal Lake		15.64	0.71	
63.	Big Pine-Nevada State Line		54.74		38.76
64.	Rt. 2 at San Juan Capistrano-Blythe		3.46	1.84	
65.	Rt. 18 near Mariposa-Auburn		32.29		20.66
66.	Rt. 5 near Mossdale-Rt. 13 near Oakdale		29.92		17.59
67.	Pajaro River-Rt 2 near San Benito River Bridge		15.37		7.13
68.	San Jose-San Francisco		28.96		12.39
69.	Rt. 5 at Warm Springs-Rt. 1, San Rafael		21.48		10.94
70.	Ukiah-Talmage		19.53		1.90
71.	Crescent City-Oregon Line		30.84		27.40
72.	Weed-Oregon Line		29.88		19.44
73.	Rt. 29 near Johnstonville-Oregon Line		28.41		35.95
74.	Napa Wye-Cordelia via Vallejo and Benicia		24.79		27.21
75.	Oakland-Jc. Rt. 65 at Altaville		25.62		16.19
76.	Rt 125 at Shaw Ave.-Nevada State Line near Benton		32.57		14.83
77.	San Diego-Los Angeles via Pomona		19.87		10.09
78.	Rt 12 near Descanso-Rt. 19 near March Field		7.76	18.90	
79.	Rt. 2, Ventura-Rt 4 at Castaic		13.94		6.86
80.	Rt 51, Rincon Creek-Rt. 2 near Zaca		14.91		4.69

Mechanical Wizardry of Highway Shop Keeps Road Equipment Available

THE war is testing to the utmost the ingenuity and inventive genius of the mechanic craftsmen and the executive staff of the Headquarters Shop, Division of Highways, in Sacramento.

It is the major function of the Headquarters Shop as well as that of the district maintenance stations to keep road construction equipment and all motor vehicles of the Department of Public Works in operating condition.

Priorities controlled by the War Production Board have become the large-sized headache to Equipment Engineer R. H. Stalnaker and his crews at Headquarters Shop. Since purchase of new equipment is restricted to an almost negligible amount, the Division of Highways is compelled to make repairs to equipment that under normal conditions would not be even considered. What with limited manpower and the great difficulty in obtaining priorities for repair parts, the men of the shops have been forced to rely upon their inventive abilities to keep road equipment rolling.

ADAPTED USED PARTS

For example, Headquarters Shop recently used heavy truck chassis, oil tanks, spray bars, pumps, piping and other pressure accessories, formerly parts of other units, and built up three 1,000-gallon insulated pressure road oil distributors that are comparable in detail with any of the later models of their capacity formerly on the market.

Confronted with the urgent need for additional equipment for road oil heating and with no such new equipment available, Headquarters Shop has undertaken the building of four portable units, two of which are mounted on old trailers. The other two units will be on steel skids.

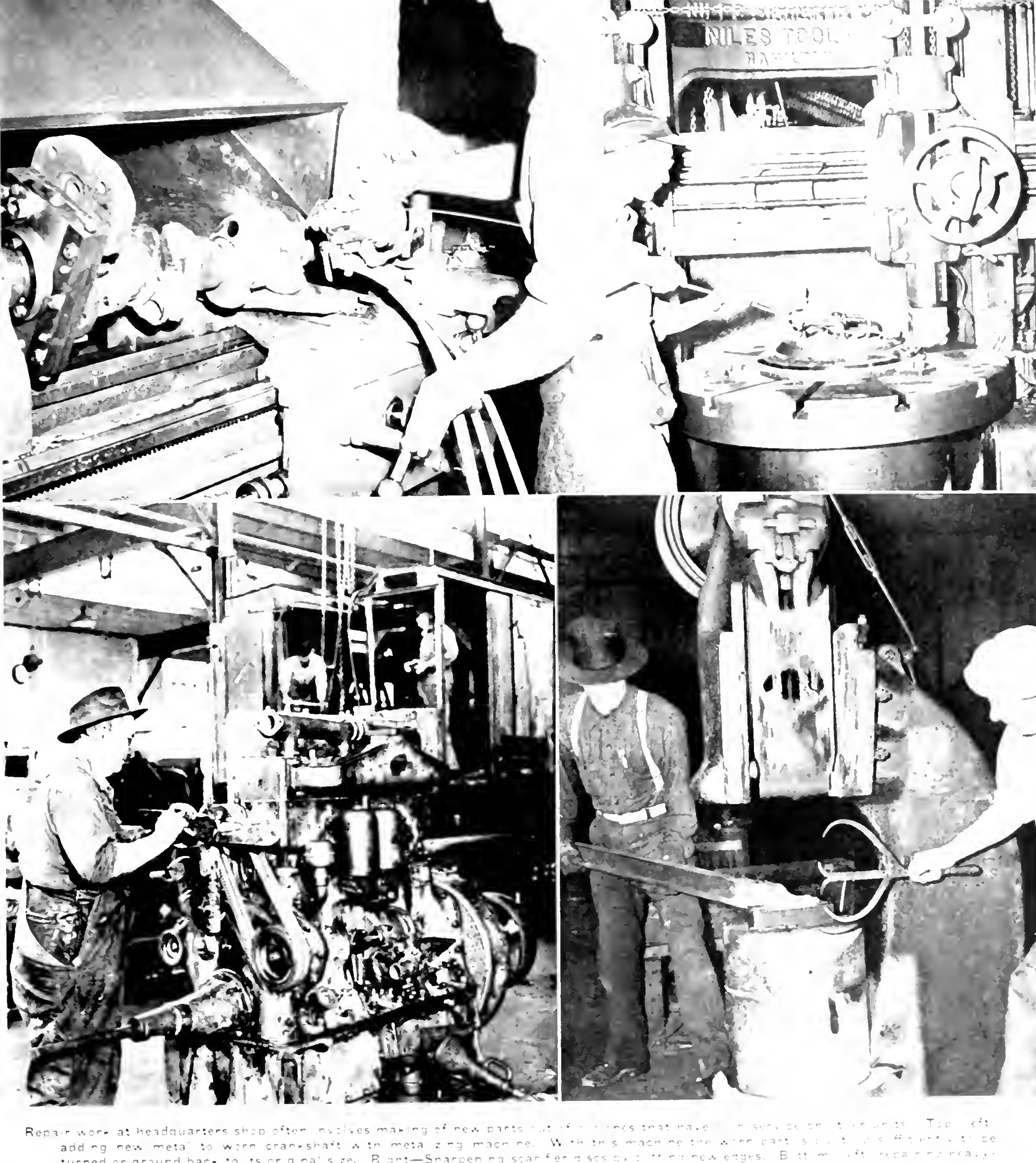
The boilers, pumps, and fittings for the trailer-mounted units were purchased second-hand and will be reconditioned, assembled and mounted by the shop forces. The same procedure will govern the construction of the other units. In the assemblying of both types, much salvaged material will be used, and the units will be built without the aid of priorities with the probable exception of two pressure oil burners.

BUILT WHEELS FOR MOWERS

Also, the Shop has just completed an oil-pumping rig, powered by gasoline engine, mounted on a two-wheeled trailer, which was constructed of salvaged units without the necessity of priorities. Failing to get a priority for the small pneumatic tires needed for the sickle-bar ground wheel on highway mowers, the Shop constructed its own wheels and faced them with available composite material easily replaced when worn.

In order to further the conservation of steel and reduce time lost in securing parts for repair, the Shop installed a

Two big power shovels transported to Sacramento Highway Shops by freight car for extensive repairs, replacements and overhauling



Repair work at headquarters shop often involves making of new parts out of [illegible] that have [illegible] in service on state units. Top left—adding new metal to worn crankshaft with metalizing machine. With this machine the worn parts [illegible] to be turned or ground back to its original size. Right—Sharpening scarifier discs by [illegible] new edges. Bottom left—repairing heavy-duty Hesselman oil engine of power shovel on which men are working in background. Right—Forging steel bar with power hammer complete metallizing outfit with which worn shafting, pump-rods, crank and cam shafts, axles, drive shafts and numerous other parts can be built up sufficiently so that they can be turned or ground back to their original size and at a cost considerably less than for new ones. This installation is an expensive one but in times like the present is well worth the cost and will give ample returns on the investment.

Large oil heating retort on trailer constructed of salvaged materials

IMPROVISED NEEDED PARTS

Repair parts, which the Division of Highways normally should have first, are seldom available for reasonably prompt delivery and are often the last to arrive; consequently, mechanics are continually changing over from job to job whenever parts are obtained that can be put in place, and the result is many valuable man-power hours are lost before the equipment is finally completed and back on the road working. As many as five pieces of major equipment have been in the shop for repairs, taken down one or more at a time, necessary parts requisitioned and then a tedious period of waiting endured before the work can be proceeded with.

Ordinary running repairs that have to be made on the road, often many miles from the Shop, are quite a problem. Prompt securing of parts is generally out of the question and Division of Highways mechanics are forced to patch or improvise to keep equipment going. How long a patching job will last is always problematical, but it has to be done. Improvisation gives results, but the cost is greater than that of replacement parts. There is a further loss of valuable man-power hours.

OLDER MECHANICS SUPERVISE

Maintenance shop mechanics for many years have relied on prompt delivery of parts and adjusted themselves to plan their work accordingly. Now that conditions have changed, the younger men need more supervision but due to the fact that many of the older mechanics are still in the State service, Equipment Engineer Stalnaker feels that the Shop has gotten along creditably under the circumstances.

Because improvisation and ability to take short cuts were part of the early training of the older employees, much has been accomplished, chiefly in readaptations of various units by taking major parts from them and combining them into others badly needed at present and not available under priority regulations.

Delay in obtaining repair parts has widely affected activities of the headquarters and district shops. One of the Division of Highways' largest district shops is crowded with units in various stages of repair with very little work being done on any of them due to lack of parts. In that same district about 40 other units that should now be in the shop, are working and in all probability some of these will be operated almost to the point of failure before the shop can get them.

Tractors, motor graders, dump trucks, and drag-line equipment when in for overhaul, present another difficulty. Floor space is limited at all shops and due to the fact that it usually takes at least 60 days, at times longer, to get complete delivery of parts requisitioned for a particular job, many manpower hours are wasted and repair costs increased.

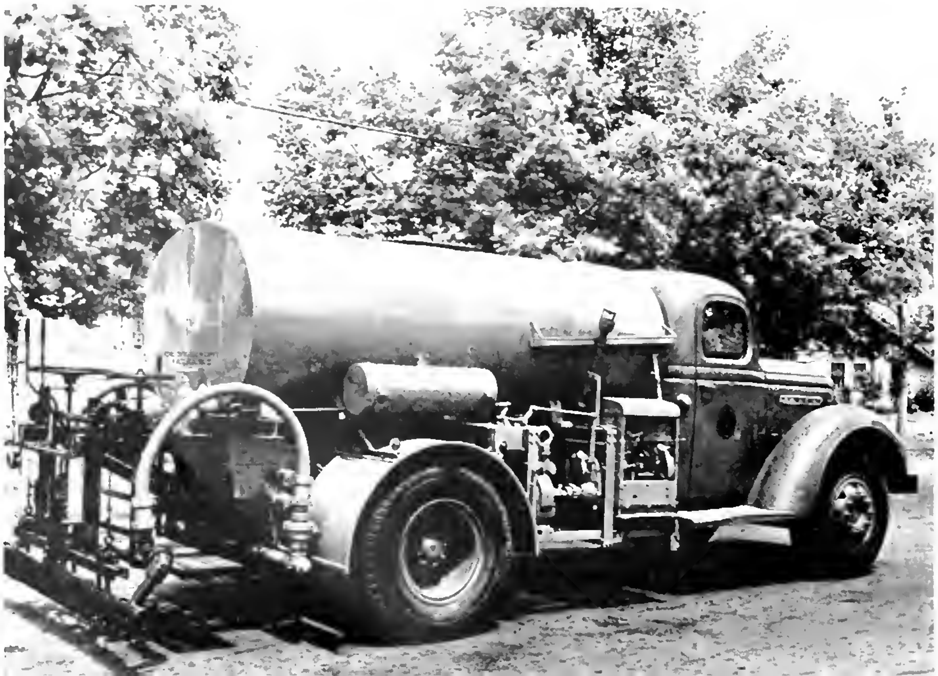
As equipment gets older, repair periods are more frequent. In many cases it is difficult to get equipment away from job sites and into the shop because those in charge of its operation know that no reliable estimate can be made as to when it will return to service; consequently, some equipment is kept working too long.

All these factors create manpower losses and no relief can be expected until delivery of repair parts can be expedited and the obtaining of some new units made easier.

This situation probably will exist for the duration.

Critics—People who go places and boo things.

1100 gallon road oil distributor built with used parts from other units



Funds Apportioned to Counties for Postwar Road Surveys and Plans

FUNDS appropriated by the Legislature to provide for plans, surveys and specifications for postwar county highway construction projects have been apportioned by Director of Public Works C. H. Purcell.

The Legislature set up a fund of $1,500,000 to be distributed to the counties on the basis of motor vehicle registration. This money became available when the act when into effect on August 4th.

Under the law, the counties must submit to the Department of Public Works for approval a list of proposed projects and a budget for the same.

McCOY DETAILS PROCEDURE

State Highway Engineer George T. McCoy has sent to all boards of supervisors copies of forms which must be filled out covering every project. His letter to the supervisors requested that budget proposals be forwarded to the Department of Public Works at the earliest possible date and gave important explanatory details.

In his letter of instruction Mr. McCoy said:

"This act has no connection with and is entirely separate from any Federal legislation.

"Funds provided by the act are for surveying and the preparation of plans and specifications only and NOT for construction or right of way. If the county desires to include more projects than the apportionment will finance, the supervisors can appropriate county money for the additional work.

"The act provides that the expenditure of the money will be delegated to a county if the Department of Public Works is satisfied that the county is equipped to conduct the work in an efficient and economical manner.

BUDGET MUST BE APPROVED

"Where the expenditure is so delegated, a warrant for the amount will be forwarded to the county for deposit in its special road improvement fund, upon approval of the budget by the department.

"The approved budget may be amended or supplemented by submitting an amended or supplemental proposal on the specified form to the department for approval.

"In judging the necessity for, or order of importance of a proposed project the principal factor will be the general usefulness of the road; its place in the county highway system; and its social and economic service, such as connecting rural communities with town, markets, railroads, water transportation or the State Highway System, serving as mail routes or school bus routes, or providing access to community meeting places.

MAINTENANCE NOT INCLUDED

"For the purposes of the act, construction will be considered as the 'improvement' of county highways consistent with funds available to counties under the Streets and Highways Code. Improvement does not include maintenance, such as the preservation and keeping of rights of way and each type of roadway, structure and facility in a safe and usable condition to which it has been improved or constructed, but does include reconstruction or other new improvement.

"The act leaves the responsibility to the county to determine the standards of alignment, width, surfacing and structure design. Surveys and plans, specifications and estimates for all projects, however, shall correspond to the character of the work proposed and shall be in sufficient detail to show the quantities and kinds of work contemplated.

"It is suggested that plans be made on sheets of the size and standard required for Federal aid feeder roads, in case Federal funds are appropriated in the future for construction.

PROJECTS IN CITIES

"It will be noted that the act includes county highways of major importance within cities. Projects within cities to be included in the budget will be determined by the county and agreed upon by the county and the respective cities within the county.

"The attached form of budget proposal was formulated for the purpose of obtaining the minimum information required for intelligent and orderly review of the proposed post-war planning program of the county; and to determine the county's ability to perform the planning work in an efficient and economical manner, as contemplated by the act. The forms are to be completely filled in. Separate 'detail data of specific projects proposed' are to be made out for each individual project.

"The projects then are to be listed on the summary sheet in their order of importance, and the summary sheet and the detail data sheet attached to the cover sheet and signed by the authorized county officials. The complete budget, together with a certified copy of the resolution adopting the budget, is to be submitted in triplicate to the appropriate district engineer of the division of highways. The budget is to be accompanied by a map of the county, indicating the various projects proposed and numbered to correspond with the project number listed in the budget.

"CAUTION: Do not make any surveys now. Prepare your list of projects to be surveyed and send them in to the State district engineer. After your program has been approved by the Director of Public Works, you can then start surveys and detail plans. No money can be paid for work done before the list of projects is approved by the Director of Public Works.

"You will note that Section 6 of the act provides that the county shall file a report with the department at the close of each fiscal year showing the expenditures made. Forms for filing the financial report will be furnished at a later date.

"It is recommended that the required budget proposal, as outlined herein, be prepared and submitted at the earliest date, so that the budget may be reviewed and approved and the funds made available in accordance with the act without delay. Every effort should be made to submit the full contemplated program at one time."

(Continued on page 15)

State Highway Maintenance Problems After Twenty Months of War

By T. H. DENNIS, Maintenance Engineer

THE maintenance forces of the Division of Highways' organization although handicapped by lack of manpower, equipment, materials and supplies have extended themselves since December, 1941, to provide normal service to the users of the highways. On the whole it is believed that the public has been well served, although in a few cases there have been protests due to limitations placed on snow removal, clearing of slides, etc., on roads which serve strictly recreational areas.

This generally favorable result has been made possible only through foresight in securing certain materials and supplies such as providing tanks for storage of bituminous materials and arranging for replacement of equipment even as far back as 1940 and early in 1941. The organization was in first class shape at the start of the war from a working point of view.

CERTAIN WORK CURTAILED

It has been necessary, of course, to limit certain phases of the work, such as changing from the solid line traffic stripe to a broken line and reducing the mileage striped, reduction in the work of care of roadsides and roadside plantings, occasional patrol of light traffic routes, delaying the spring opening of mountain roads closed by winter snow, and similar items.

It must be realized, however, that as time passes the advantages obtained through early preparation are diminishing and at the same time there is every prospect that demands will increase. Factors which must be considered are (1) traffic demands, (2) condition of the highway system on the one hand and on the other (3) the status of finances and (4) the working organization including such considerations as manpower, equipment, materials and supplies.

The total traffic volume at the present time is about 70 per cent of the corresponding 1941 volume. However, the truck and bus traffic volume is at present about 94 per cent of the 1941 volume. Furthermore heavier loads are being hauled as a result of shortage of equipment and efforts of the Office of Defense Transportation to insure maximum efficiency.

The use of diesel oil for the first half of 1943 was some 8 per cent greater than for the corresponding period in 1942. From results of other studies it appears that the ton miles developed by commercial vehicles therefore is at least as great as in 1941. There is more hauling during the winter seasons than prior to 1941.

MAINTENANCE NEED INCREASED

As truck traffic is the portion of the traffic which most seriously damages road surfaces and structures it is evident that the need for adequate maintenance has not declined. It is to be expected that the highway system of the coast States will, in the near future, become even more important to the war effort. More and more units of the fleet will be based in the Pacific area accompanied by Army expeditions, and such shifting of emphasis can not fail to bring increased demands on the highways.

In the face of sustained demands on the facilities there has been a falling off of the total revenue available for highway purposes. It is not expected that amounts available for State Highway maintenance purposes will be materially reduced during the current biennial period, unless further restrictions are placed on the use of automobiles.

No new construction or even reconstruction projects are being placed under way except Federal access road projects. Such projects are restricted by Federal control to work essential to prosecution of the war.

COSTS OF WORK GREATER

Day by day the road surfaces and structures are getting older and with the postponement of the reconstruction program an increasing burden rests on the maintenance organization.

There is likewise a constant increase in the cost of performing work. Wages are increased as a result of statutory increases and the wartime emergency increase. Delays result from breakdown of the equipment and deliveries of materials, and men are not available to fill in crews assigned to the major items of work.

This latter situation is especially serious as it requires transfer of men from one point to another which not only requires careful programming of the work, but causes unavoidable and expensive delays. There is also the additional expense involved in the transportation and support of the men while on temporary assignments.

LOSS OF MANPOWER

As a whole the organization is from 25 to 30 per cent below minimum requirements in numbers. Many of the men lost both to the Army and defense work were the younger men. Replacements have been made as far as possible, but these men are older and not so well trained or adaptable.

Women are being employed to some extent as flagmen and on other light work. While the organization is functioning well the strain is felt whenever an emergency develops which requires long hours and night work. Any State-wide or extended emergency period would cause a breakdown in the field service.

The matter of equipment is of particular concern. Only a few pieces of new equipment have been secured during the past two years and there have been no replacements. There are many units in service which would have been retired under normal conditions, for example:

SERIOUS EQUIPMENT SITUATION

- 22% of the trucks are 7 years old or older
- 20% of the power shovels are 7 years or older
- 21% of the motor graders are 7 years old or older
- 32% of the snow plows are 10 years old or older

Naturally as the equipment becomes older breakdowns are more frequent. Since an adequate stock of replacement parts can not be carried by the State,

(Continued on page 15)

Some maintenance jobs. (1) Section of State Highway surface in Santa Barbara County destroyed by military traffic. (2) Damaged surface of State Highway in Imperial County by hauling operations due to war emergency. (3) Damage to surface of State Highway in Merced County by contractors equipment hauling to defense project. (4) Section of State Highway surface in San Bernardino County damaged during military maneuvers

Maintenance Considerations of Culvert Design and Practice

By C. F. WOODIN, Assistant Maintenance Engineer
G. A. TILTON, Jr. Assistant Construction Engineer

Foreword

This is the tenth and concluding article of a series of technical abstracts from a joint departmental review of culvert practice of the California Division of Highways by a committee composed of R. Robinson Rowe, Assistant Bridge Engineer, R. L. Thomas, Assistant Engineer Surveys and Plans, and the writers.

The series is concluded with a review of the nine preceding articles with particular reference to culvert maintenance.

THE predominant theme of the preceding articles is the concept of designing culverts to pass the 100-year flood without serious damage to the culvert or highway embankment and at no general appreciable increase in cost over the present practice of designing for the 10-year flood.

To accomplish this objective, and develop full economic value of the culvert, it should be designed, within safe limitations, to operate with sufficient head on the entrance to cause it to run full for the greater part of the length. A combination of these hydraulic considerations with properly proportioned appurtenances has been termed* "balanced design" by the committee.

Floods of unusually high intensity-frequency may be expected somewhere in California every year, either in scattered small areas, or in a few localized larger areas. In most cases serious damage results and it is the two-fold function of the maintenance forces (1) to make immediate minimum repairs to restore traffic and halt erosion, and (2) after study, to make permanent repairs to conform with recommended "balanced design."

Failure may not be due to hydraulic deficiencies alone. Inspection and analysis may reveal the cause of failure to be a combination of hydraulic inefficiencies and lack of adequate appurtenances.

CORRECTIVE MEASURES

Debris Barriers

Field inspections made immediately after storms, and consultation with field maintenance personnel, show debris congestion at culvert entrances to be the greatest contributing cause of culvert failures.

It is not always possible for designers to anticipate the necessity for debris control measures. In a period of ten to twenty years natural conditions may be aggravated by changes in the culture of tributary basins from logging or clearing operations, farming operations, changes from rural cultivation to urban built-up areas and similar transitory conditions.

It is incumbent upon maintenance supervision to observe these changes from one phase to another and anticipate proper protective measures.

As outlined in the second article of this series, the committee found no consistent policy of debris control. As a result, debris devices were classified and adapted to varied conditions for the benefit of the maintenance engineer as well as the designer.

The problem of installing debris control appurtenances is simplified by their external location. Barriers should be placed so as to provide maximum efficiency in intercepting debris with minimum obstruction to flood waters. The ideal layout permits the deflection or collection of debris in a reservoir having sufficient capacity to store a full seasonal deposit.

Maintenance of debris racks and de-silting basins is one of the chief concerns of the maintenance personnel. Where debris and silt deposits have approached capacity stage, immediate removal may be imperative, although it is generally more economical to allow the deposits to become dried out before removal. Deposited material which interferes with the full use of drainage facilities may be viewed in the same light as slide material which completely obstructs the traveled way.

Culvert Location and Slope

The review of culvert practice indicated a general tendency of designers and field engineers to locate culverts on straight alignment and straight slopes away from channel beds for the exclusive purpose of shortening the length to reduce the cost over an installation in the channel proper.

The committee has made a strong recommendation for locations that follow the general alignment and slope of natural channels—on curves and properly broken slopes if necessary.

Culvert failures, caused by improper locations, which result in washouts, generally provide opportunities under maintenance to relocate them in their proper positions, or realign their outlets to insure safe discharge, particularly where they have been installed in "side-hill location" with entrances and outlets well above the channel bottom.

Culvert Entrances and Headwalls

Arbitrary selection of headwalls and lack of attention to entrance efficiency led the committee to classification of headwalls and recommended adaptations to various entry conditions. Likewise, types of entrance treatments were analyzed and classified.

Wherever the maintenance engineer is faced with the necessity of increasing the capacity of an existing culvert, improvement of the entrance should be the first condition to be analyzed.

Culvert Outlets and Endwalls

Recent design of large metal multiplate culverts and large concrete arch and box sections without consideration of the damaging effect of high outlet velocities developed when operating at designed capacity, has tended to focus

* See page 13, July-August, 1943, issue of California Highways and Public Works.

attention on methods of preventing ensuing damage.

Recommendations of the committee limit outlet velocities to a designed maximum of twenty feet per second and the installation of energy-dissipators, if necessary, to prevent damage to the culvert, highway embankment or private property.

If improvement of property has taken place below the outlet of a large culvert and if discharge velocities prove damaging, methods of dissipating energy should be considered a maintenance problem, as outlined in the fifth article of this series.

Development of Siphonic Action*

As pointed out by the *committee, the development of siphonic action to increase the capacity of existing undersized culvert barrels can often be utilized to economic advantage. In many cases under high embankments where it is impractical to enlarge or install an additional culvert, increased capacity can be developed by siphonic action. Under roadways with little headroom, capacity can be increased in certain cases by use of the flared-siphon culvert, which is particularly adapted to widening operations.

Culvert Size

In the case of an existing culvert which has proved to be inadequate hydraulicly, additional consideration should be given to improving capacity by use of rounded or throated entrances, warped wing walls, or lined training channels. If sufficient capacity can not be developed by any of the above methods, an additional culvert or culverts should be installed or the same culvert relocated where sufficient head can be utilized to develop the desired capacity to fulfill the requirements of "balanced design."

Historical Record

Historical data in regard to the more important culverts where debris, erosion, or other conditions have presented specific problems, are of inestimable value both in regard to conditions at their particular locations and to providing a basis for future design. The acquisition of information concerning actual performance of the culverts logically rests with maintenance field personnel, and should be readily accessible to the designing engineer. It is of particular value to record flood stage elevations while identifying evidence is yet clearly discernible.

These data, for reasons of uniformity and ready reference, should follow some order as indicated by the following check list:

(DATE REPORT)

A. FLOOD STAGE
- a. Height above invert at entrance.
- b. Height above invert at outlet.

B. CONDITION OF CULVERT
- a. Metal—1. Extent of abrasion, 2. Pitting, 3. Rust, 4. Rivet and bolt condition.
- b. Concrete—1. Extent of spalls and abrasion, 2. Reinforcing exposed, 3. Cracks—location, extent, 4. Undermined side walls.
- c. Joints—1. Open—location, 2. Water entering or disappearing through joints.
- d. Drift and detritus (in barrel)—1. Kind and amount.

C. ENTRANCE (CHANNEL, HEADWALL, DEBRIS RACK)
- a. Scour (describe location and extent) 1. In channel, 2. Headwall, 3. Wingwalls, 4. Embankment slopes.
- b. Obstructing vegetation—1. Nature and extent.
- c. Drift and detritus deposit (describe nature and extent)—1. In channel, 2. At entrance, 3. On debris rack (if any), 4. In debris reservoir (if any).

D. OUTLET (CHANNEL, ENDWALL, VELOCITY, CHECK, ETC.)
- a. Scour (similar to entrance).
- b. Obstructing vegetation (similar to entrance).

E. ROADWAY PRISM
- a. Settlement over culvert—1. Amount of sag in grade, 2. Length of roadway affected.
- b. Probable cause of settlement—1. Saturation following blocking of inlet, 2. Saturation through culvert joints, 3. Other causes.

F. WORK DONE (give dates)
- a. Removal of debris, detritus
- b. Additional erosion protection
- c. Repaving invert, etc.
- d. Construct debris rack
- e. Other.

G. RECOMMENDATIONS
- a. Work needed beyond the scope of ordinary maintenance—1. Construct debris rack, 2. Lower footings, cutoff walls, etc., 3. Raise headwall to increase head at entrance, 4. Construct flared siphon outlet, 5. Place riprap, etc., 6. Other.

Brief Summary of Committee Recommendations

1. Culverts should be designed to meet the requirements of "balanced design" to pass the 100-year flood safely with sufficient head on the culvert entrance to make the culvert run full.
2. Debris control devices should be provided at culvert entrances where required to prevent clogging.
3. Culverts should be located insofar as practical and economical in the approximate course and slope of natural channels.
4. Culvert entrances should be designed for hydraulic efficiency and headwalls should be proportioned with zero free board, to protect the embankment against the 100-year flood head on the entrance.
5. Excessive outlet velocities should be limited and controlled, if necessary, with energy-dissipator works or other means. Endwalls should not be arbitrarily selected but should be adequately designed to protect the embankment.
6. Development of siphonic action in culverts should be utilized where economic.
7. The basic principles of earth pressures transmitted to culverts and effect on various field conditions should be given greater consideration in design and field installation.
8. Waterway ratings should be considered for all large drainage culverts.
9. Selection of size and type of culvert should be based on sound hydraulic and engineering factors.
10. A systematic record of all troublesome culverts and all failures should be kept by maintenance personnel for future corrective measures or reconstruction.

LIST OF ARTICLES ALREADY PUBLISHED IN CALIFORNIA HIGHWAYS AND PUBLIC WORKS

August, 1942—Preliminary Outline of Articles.

September, 1942—Comparative Hydrology Pertinent to California Culvert Practice.

October, 1942—Debris Control at Culvert Entrances on California State Highway System.

November, 1942—Highway Culvert Location and Slope From a Review of California Practice.

December, 1942—Culvert Entrances and Headwalls on California Highway System.

January, 1943—Culvert Outlets and Endwalls on California Highway System.

February, 1943—Utilization of Siphon Principles in California Culvert Practice.

March-April, 1943—Earth Loading Factors Affecting Field Installations of Culverts.

May-June, 1943—California Adopts Waterway Ratings for Large Drainage Culverts.

July-August, 1943—Committee Recommendations for Selection of Culvert Size and Type.

* See February, 1943, California Highways and Public Works.

Road Reinventory Being Made With Portable Automatic Traffic Counters

By R. E. PIERCE, Principal Highway Engineer

During 1941 and 1942, the Highway Planning Survey started a field reinventory of all the roads in the State other than State highways.

This reinventory made at the request of the Public Roads Administration was planned with the object of completing about one-fifth of the road mileage each year so that at the end of five years the entire road system would be covered and new maps made. Then the process would be repeated, taking the counties in the same order as before. Thus, none of our maps or other data would ever be more than five years old.

During the original survey, traffic counts were made at about 2,500 stations located so as to give a thorough coverage of the State. These counts were made manually by persons located at each station, the number ranging from one to six individuals depending upon the density of the traffic and other conditions.

THREE TYPES TESTED

About the time the reinventory survey was started, tests were made of three portable automatic recorders of two makes. These will be identified as Make A No. 1, Make A No. 2, and Make B.

Both makes are operated by electric current from dry cell batteries, the counting mechanism being actuated by air impulses set up by the impact of the tires of vehicles crossing a rubber tube stretched across the roadway and connected to the instruments.

A series of tests were conducted on these counters during 1941 on various highways in the vicinity of Sacramento, having two, three and four lane sections. The results of these tests were tabulated, the portable recorder count being checked by a manual count in which the number of vehicles were determined in the same manner as our standard practice in traffic counting—that is trailers were counted as separate vehicles but tractors with semitrailers were counted as one vehicle.

TESTS SHOWED ERRORS

The Make A counters were tested for four days prior to the arrival of the Make B counter. The overall errors for the four days were 1.51 per cent for Make A No. 1 and 1.39 per cent for Make A No. 2. However, both counters showed errors for a single day in excess of 3 per cent.

Upon arrival of the Make B counter all these counters were tested for five days more. The average errors for these five days were found to be plus 1.57 per cent for Make A No. 1; plus 1.36 per cent for Make A No. 2 and minus 1.42 per cent for the Make B counter.

The results obtained from the Make A counters checked closely with those obtained in the first four days of testing. The overall error on the Make B counter is approximately equal to the Make A counters and furthermore its operation is more consistent, the errors for any one day being less than 2 per cent and always in the same direction, minus.

The Make A counters showed errors for individual days in this group of tests of 2.30 per cent and 4.60 per cent respectively. This is apparently due to the extreme sensitivity of the Make A counters. The errors are nearly always in the plus direction.

COUNTS EVERY AXLE

The Make A counter seldom fails to count every axle crossing the road tube. The Make B counters, on the other hand, tend to miss axles occasionally, particularly the second axle of vehicles with dual rear axles, which accounts for the very good accuracy obtained from this counter.

All three counters tested gave sufficiently accurate results to warrant their use in highway traffic counting. If traffic were measured in terms of axles passing a given point, the Make A counters would be definitely preferable as they count axles more accurately. However, with traffic counted in terms of vehicles it was believed the Make B counter produces slightly more accurate results and with possibly greater consistency, since it appeared to be less sensitive to slight changes in adjustment.

For these reasons, a total of 47 of the latter instruments were purchased, the specifications being as follows:

1. Size 6″ long by 4¾″ wide by 4″ high. Weight, 9 pounds. The aluminum casting is moisture and dust proof and has a window in the top for the reading of counter figures. The cost including tubing and clamps was approximately $30 per unit.

2. The counter mechanism consists of a special wound solenoid coil and a Veeder Root counter. The counter is actuated when contact is made by an air-electric relay switch. The contact points are silver and are so arranged that it is not necessary to disconnect the battery to adjust the points.

BATTERY SPECIALLY BUILT

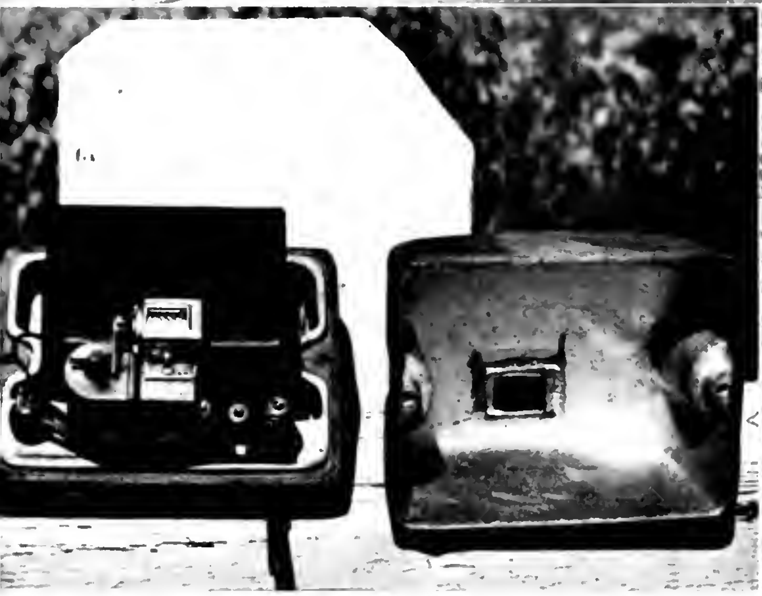
3. The dry battery is a specially built high amperage type, size 2½″ x 2¾″ x 4″, approximate life is 200,000 contacts. Replacement cost $1.50.

4. The detector tube used is size $^{9}/_{16}$″ outside by $^{3}/_{16}$″ inside diameter. The counters will operate satisfactorily with detector tubes up to 60 feet in length. One end of the detector tube connects to the recorder, the free end being plugged. The detector tube is made fast on both sides of the highway by clamps placed around the tube and nailed into the highway shoulder. The recorder itself is chained and locked to any upright post or tree on the right-of-way.

These 47 Make B and the two Make A counters were used in making counts in 10 of the 11 counties selected for the first reinventory.

TWENTY-FOUR HOUR COUNTS

The plan was for the fieldman to set out the counters at points previously determined on the road maps. Each count was for a 24-hour period. This permitted the field men to place the instruments and take initial readings at such times as were convenient during normal working hours and arrange to take final readings and pick



Top photo shows typical installation of automatic traffic counter on highway. Black line on pavement in foreground is 9 16 inch rubber tubing that actuates counting machine. Lower pictures show recording mechanism in box which is secured to post by lock and chain

up instruments in the same sequence 24 hours later. Since the instruments were generally spread over a distance not exceeding 20 miles for a specific area the slight time offset between successive counters did not introduce any material error in results and also largely eliminated overtime for the field men

The tabulation shows the cost of this operation by county. The cost per counter per day varies from a low of $1.34 to a high of $1.39 with an average of $1.71 The variation in cost is primarily due to the variation in distance from Sacramento of the field of operations and to the relative density of the road grid in the several counties. With a dense road grid a larger number of counts can be obtained per day due to shorter mileage between stations.

LACK TRAFFIC CLASSIFICATION

The principal disadvantage of automatic counting is the lack of any segregation of the traffic into various classifications such as trucks, buses, foreign cars, etc This was overcome to some extent by having the field men make four-hour manual classification counts at representative automatic counter stations in spare time available after setting out the counters

A total of 56 such manual counts were obtained during the course of the automatic counting program On the basis of data so obtained it was possible to compute the distribution of the various vehicle types in terms of percentage of total traffic at the specific locations where manual counts were made. By combining the results of all such counts in a county or other geographic area, average distribution factors were obtained by means of which calculations of vehicle type distributions at other counter locations could be obtained with a fair degree of accuracy.

Accidents Decrease on Rural State Highways

THE trend of traffic accidents on the rural State Highway System for the first six months of 1943 as compared with a similar period for 1942, is considerably more favorable than on city streets and county roads, according to Director of Public Works C. H. Purcell.

For the periods under consideration, Director Purcell said, there was a 41 per cent decrease in reported traffic accidents as compared with a 22 per cent decrease in traffic on the rural State Highway System. Considering the State as a whole, there was a decrease of 17 per cent in reported accidents as compared with a 21 per cent decrease in traffic. On the same basis of comparison, total gasoline consumption shows a decrease of 18 per cent.

"It must be pointed out, however," Director Purcell said, "that during the first six months of 1943 there were 817 more pedestrians injured and 53 more killed than during a like period in 1942, and that pedestrian accidents influence the accident record on city streets to a major extent. This record admittedly is for a short period of time and is thus a meager sample upon which to base fixed conclusions."

Chester H. Warlow

(Continued from page 5)

He is a director of the Sierra National Parks Highway Association, being one of the founders of that organization and chairman of the San Joaquin Valley State-wide Water Committee from 1930-1940; member of the Fresno Rotary Club; American Legion Post No. 4 and Sequoia Sunnyside Club. He was the leader of the community effort that resulted in the construction of Kings Canyon Highway, Fresno-Yosemite Highway, and the Generals Highway.

He entered the oil business in 1898 by purchase of stock of the Blue Goose Oil Company in the Coalinga oil fields and is president and principal owner of the Ward Oil Company and Seneca Oil Company, both producing companies in the Coalinga area. He is also director and member of the executive committee, Independent Oil Producers Agency of California.

Mr. Warlow enlisted in the regular Army Signal Corps in August 1917, was commissioned second lieutenant, December 1917, and assigned commanding officer of Flying Cadets, Cadet Wing, Kelly Field; adjutant of Cadet Wing in charge of Ground School Sections; commissioned First Lieutenant June 15, 1918; and recommended for commission as Major in Air Service, October 1918.

He is married and has no children.

County Postwar Road Funds Apportioned

(Continued from page 11)

Following is the apportionment as announced by Director C. H. Purcell:

County	Registered vehicles	Amount
Alameda	204,803	$92,720.28
Alpine	112	5,047.97
Amador	2,747	6,176.58
Butte	17,600	12,538.35
Calaveras	2,854	6,222.41
Colusa	4,343	6,860.17
Contra Costa	63,251	32,031.38
Del Norte	1,627	5,696.87
El Dorado	4,331	6,855.03
Fresno	72,711	36,143.24
Glenn	5,565	7,383.58
Humboldt	17,114	12,330.19
Imperial	19,107	13,183.82
Inyo	3,306	6,416.01
Kern	54,661	28,412.15
Kings	14,943	11,400 32
Lake	3,868	6,656.72
Lassen	5,561	7,381.86
Los Angeles	1,156,981	500,552.78
Madera	9,449	9,047.15
Marin	20,029	13,578.73
Mariposa	1,455	5,623.20
Mendocino	8,714	8,732.34
Merced	19,523	13,362.00
Modoc	3,155	6,351.34
Mono	567	5,242.86
Monterey	30,850	18,213.53
Napa	13,728	10,879.91
Nevada	4,808	7,059.34
Orange	63,233	32,083.67
Placer	10,164	9,353.40
Plumas	3,590	6,537.65
Riverside	43,014	23,423.55
Sacramento	73,338	36,411.79
San Benito	5,086	7,178.41
San Bernardino	66,617	33,533.09
San Diego	139,834	64,893.06
San Francisco	184,015	83,816.46
San Joaquin	55,739	28,873.87
San Luis Obispo	16,213	11,944.28
San Mateo	48,688	25,853.82
Santa Barbara	28,256	17,102.48
Santa Clara	74,073	36,726.61
Santa Cruz	17,590	12,534.07
Shasta	11,652	9,990 73
Sierra	743	5,318.24
Siskiyou	10,269	9,398.37
Solano	32,280	18,826.02
Sonoma	31,676	18,567.32
Stanislaus	34,347	19,711.35
Sutter	7,929	8,396.11
Tehama	5,871	7,514.64
Trinity	906	5,388.05
Tulare	42,105	23,034.22
Tuolumne	3,514	6,505.10
Ventura	26,590	16,388.91
Yolo	12,518	10,361.65
Yuba	7,408	8,172.96
Totals	2,825,021	$1,500,000.00

Maintenance Problems After 20 Months of War

(Continued from page 12)

and in fact is not available on the coast, the breakdown of equipment in certain circumstances may become a serious matter.

Some difficulty has been experienced in securing plant-mix and other material required for maintenance work due to the demands as a result of extensive construction for airports and other military establishments. This has been overcome largely by stockpiling plant-mix and aggregates in considerable quantities in the off season, and by seeing to it that all available tank storage is kept filled with bituminous materials.

The main concern at the present time is the possibility that further restrictions may be placed on the manufacture of liquid asphalts. In that event, changes in maintenance methods and equipment would be necessary. Such changes in many cases would require time as well as securing new equipment which is on the critical list.

BLANKET TREATMENT LIMITED

As time passes the maintenance of the highway system will become more difficult due to the very limited construction and reconstruction program. Construction funds have been inadequate over a long period to fully develop the highway system. As a result the reconstruction of surfacing has been sacrificed in order to secure proper location with the thought that this deficiency could be corrected later.

In 1940 it was estimated that reworking or reconstruction of the surfacing on the rural State highway at a rate of 10 per cent, or over 1200 miles per year, was required to care for traffic needs. This deficiency is being made up to some extent by a program of blanket treatments.

Funds limit this program, however, to about 400 miles per year. War Production Board restrictions limit such work to a minimum design so that benefit from such work can be expected for only a three to five year period when further reinforcement or reworking must be provided. It is evident then that if the war continues even two years longer, the State highways will have deteriorated in very considerable degree.

Telephone operator to new girl she is breaking in: "No, honey, you say 'just a moment, please,' not 'Hang on to your shirt, mister.'"

Highway Bids and Awards for August and September 1943

ALAMEDA COUNTY—Between Toll Plaza and Distribution Structure about 1.3 miles, imported borrow to be furnished and placed, plant mixed material to be placed as base and surfacing, asphalt concrete pavement to be constructed and seal coat to be applied to plant mixed surfacing and imported borrow on parking areas and shoulders. District IV, Routes 5, 69. Chas. L. Harney, San Francisco, $97,475; Gallagher & Burk, Oakland, $100,062. Contract awarded to Lee J. Immel, Berkeley, $91,925.

ALAMEDA COUNTY—Between Dublin and Castro Hill, portions only, about 3.9 miles, to be repaired with asphalt concrete. District IV, Route 5, Section B. Lee J. Immel, Berkeley, $97,953; A. Teichert & Company, Sacramento, $97,964. Contract awarded to Louis Biasotti & Son, Stockton, $94,314.

CONTRA COSTA COUNTY—Near Pittsburg and near Brentwood, about 2.9 miles to be repaired with plant mixed material on crusher run base and applying a seal coat. District IV, Route 75, Sections C,D. Lee J. Immel, Berkeley, $50,184; E. A. Forde, San Anselmo, $51,130; Louis Biasotti & Son, Stockton, $52,244. Contract awarded to Claude C. Wood, Lodi, $48,052.

DEL NORTE COUNTY—Between Crescent City and Smith River Bridge, portions only, about 4.7 miles, to be repaired with imported base material and armor coat. District I, Route 71, Section A. Mercer Fraser Co., Eureka, $50,030. Contract awarded to Marshall S. Hanrahan, Redwood City, $49,652.

EL DORADO AND AMADOR COUNTIES—Across the Cosumnes River about 10 miles south of El Dorado, the existing timber truss span to be repaired. District X, Route 65, Sections C,A. M. E. Whitney, Bakersfield, $14,420; James H. McFarland, San Francisco, $14,784; F. Kaus, Stockton, $15,505. Contract awarded to M. A. Jenkins, Sacramento, $13,914.

FRESNO AND MERCED COUNTIES—Between Eagle Field and Russell Avenue, about 1.2 miles to be graded and bituminous surface treatment applied; and between South Dos Palos and Dos Palos, about 2.0 miles to be surfaced with road mixed surfacing. District VI, Eagle Field. M. W. Stanfield Company, Los Angeles, $36,066; J. E. Haddock, Ltd., Pasadena, $42,849. Contract awarded to Brown, Doko and Baun, Pismo Beach, $35,948.

LOS ANGELES AND VENTURA COUNTIES—Ventura Boulevard, between Calabasas and Newbury Park, portions only, about 4.4 miles, to be repaired with plant mixed material. District VII, Route 2, Sections C,A. Southwest Paving Co., Roscoe, $33,010. Contract awarded to Schroeder & Co., Inc., Roscoe, $31,372.

LOS ANGELES AND ORANGE COUNTIES—On Firestone Blvd., between Marquardt Street and Coyote Creek, and on Imperial Highway between Route 62 and Puente Road, about 3.8 miles, to be repaired with plant mixed material and bituminous surface treatment. District VII, Routes 174 and 176, Sections B,A. Oswald Bros., Los Angeles, $19,922; Vido Kovacevitch, South Gate, $21,405; Pacific Rock & Gravel Co., Los Angeles, $22,910. Contract awarded to Griffith Co., Los Angeles, $19,639.

MARIN COUNTY—Reed Road and Tiburon Boulevard, between State Highway Route 52 and 4 miles easterly, about 3.9 miles to be graded, crusher run base to be constructed and armor coat to be placed. District IV. Lee J. Immel, Berkeley, $190,407; Macco Construction Co., Oakland, $168,207; Fredrickson & Watson Construction Co., Oakland, $170,880; A. G. Raisch, San Francisco, $222,464. Contract awarded to Heafey Moore Co., Oakland, $121,939.

MENDOCINO COUNTY—Between Dimmick Memorial Park and Mendocino, about 3.2 miles, to be repaired with imported base material and a seal coat. District I, Routes 48, 56, Sections C,D. Elmer J. Warner, Stockton, $34,877; Fred J. Maurer & Son, San Francisco, $44,020. Contract awarded to Ted Watkins, Lincoln, $32,762.

MERCED COUNTY—Between 2.5 miles north of southerly Merced County line and Lingard, about 6.1 miles, to be repaired by the road mixed method on untreated rock base. District X, Route 4, Section A. Claude C. Wood, Lodi, $73,470; Brown, Doko & Baun, Pismo Beach, $77,670; Granite Construction Company, Watsonville, $79,625; Louis Biasotti & Son, Stockton, $80,630; J. E. Haddock, Ltd., Pasadena, $104,295; M. W. Stanfield Co., Los Angeles, $104,920. Contract awarded to Phoenix Construction Co., Bakersfield, $61,131.

MONTEREY AND SAN BENITO COUNTIES—Portions between Santa Rita and San Benito River, about 3.0 miles, to be repaired with plant mixed material. District V, Route 2, Sections J,B. M. J. Ruddy & Son, Modesto, $21,830. Contract awarded to Granite Construction Co., Watsonville, $15,240.

VARIOUS COUNTIES IN DISTRICT III—Painting maintenance station buildings at Tahoe City, Meeks, Nevada City, Roseville, Williams, Chico, Marysville, Truckee, Donner Summit, Yuba Gap, Colfax and Sierraville. Hastings & Wilson, Yuba City, $8,845; Deemer & Deemer, San Francisco, $6,790. Contract awarded to Acme Painting Service, Sacramento, $5,568.

RIVERSIDE COUNTY—Between San Diego County line and Corona and between Elsinore and Route 19, about 41.4 miles, to [illegible]

[illegible] District VIII, Routes 77 [illegible] A,B,C,D,E [illegible]

RIVERSIDE COUNTY [illegible]

SAN DIEGO COUNTY [illegible]

SHASTA COUNTY [illegible]

SAN LUIS OBISPO COUNTY [illegible]

SAN JOAQUIN COUNTY [illegible]

SOLANO COUNTY [illegible]

SOLANO AND NAPA COUNTIES [illegible]

SUTTER COUNTY [illegible]

TRINITY COUNTY [illegible]

Congratulations From Truck Industry Editor

Motor Transportation
Los Angeles, California

August 27, 1943

Editor
California Highways and
Public Works
P. O. Box 1499
Sacramento, Calif.

Dear Sir:

Heartiest congratulations to you and your publication on the article in the July-August issue dealing with truck traffic on the California Highway System.

Glad to see your magazine give this recognition to the importance of motor transport and I am sure the industry will benefit as the result of your presentation.

Kind personal regards.

Sincerely yours,

(Signed) Roy H. Compton
Editorial Director

ALAMEDA COUNTY—In the city of Oakland on Twenty-second Street between Peralta Street and Wood Street, about 0.25 mile to be graded and paved with portland cement concrete and asphalt concrete. District IV, Gallagher & Burk, Oakland, $21,690; Lee J. Immel, Berkeley, $24,613. Contract awarded to Louis Angelus Co., Oakland, $21,135.

CONTRA COSTA COUNTY—Between Danville and one mile north, a portion of the state highway to be repaired. District IV, Route 107, Section A. Lee J. Immel, Berkeley, $14,458; E. A. Forde, San Anselmo, $17,512; Louis Angelus Co., Oakland, $17,959. Contract awarded to Union Paving Co., San Francisco, $13,826.

CALAVERAS COUNTY—Between San Andreas and Angels Camp, about 6.8 miles to be repaired by the road mixed method. District X, Route 65, Section B. Harms Bros., Sacramento, $28,950; Phoenix Construction Co., Bakersfield, $30,145; A. A. Tieslau Son, Berkeley, $32,080; R. A. Westbrook, Sacramento, $32,200. Contract awarded to A. Teichert & Co., Sacramento, $24,580.

DEL NORTE COUNTY—In Crescent City, a reinforced concrete box culvert at Elk Creek to be constructed. District I, Route 1, Section Cr. C. E. E. Smith, Hilt, $22,845; C. C. Gildersleeve, Colusa, $22,994; Mercer Fraser Co., Eureka, $25,020. Contract awarded to Flotation Systems, Inc., Los Angeles, $18,934.

IMPERIAL COUNTY—At points between Indio and Brawley, 11 timber bridges to be repaired. District XI, Route 26, Section E. Fred D. Kyle, Los Angeles, $20,616; Contracting Engineers Co., Los Angeles, $24,449; Byerts & Dunn, Los Angeles, $29,766; Walter H. Barber, San Diego, $29,914; Ralph A. Bell, San Marino, $32,520. Contract awarded to C. B. Tuttle, Wilmington, $19,187.

LASSEN COUNTY—Near Honey Lake, an area to be graded and portions to be surfaced with plant-mixed surfacing and with portland cement concrete pavement. District II. R. A. Westbrook, Sacramento, $767,786; E. B. Bishop, Orland, $582,125; A. Teichert & Co., Sacramento, $592,333; Parish Bros. & A. S. Vinnell Co., Sacramento, $611,201; Bressi & Bevanda Constructors, Inc., Los Angeles, $914,870. Contract awarded to Radich & Brown, San Leandro, $521,900.

LOS ANGELES COUNTY—On Fries Avenue, La Paloma Avenue and Falcon Street from Anacapa Street to San Clemente Avenue, about 0.5 mile to be graded, portland cement concrete pavement to be constructed and bituminous surface treatment to be applied to shoulders. District VII, Morman Island. Contract awarded to Griffith Co., Los Angeles, $25,458.

LOS ANGELES COUNTY—On Pearl Street, between Sepulveda Boulevard and Centinela Avenue in the city of Los Angeles, about one mile to be surfaced with plant mixed surfacing. District VII, Pearl Street. Vido Kovacevitch, South Gate, $19,410; Griffith Co., Los Angeles, $20,745; Oswald Bros., Los Angeles, $20,940. Contract awarded to C. O. Sparks & Mundo Engineering Co., Los Angeles, $17,555.

LOS ANGELES COUNTY—East Broadway between Crenshaw Blvd. and Doty Avenue, about 0.7 mile to be graded and surfaced with plant mixed surfacing. District VII. Vido Kovacevich, South Gate, $38,959; R. R. Hensler, Glendale, $39,628; Griffith Co., Los Angeles, $43,008. Contract awarded to Oswald Bros., Los Angeles, $32,377.

NAPA COUNTY—Between Third Street in Napa and Suscol Creek, about 4.3 miles to be graded and paved with portland cement concrete. District X, Route 8, Section Nap.,B. Lee J. Immel, Berkeley, $420,002; Chas. L. Harney, San Francisco, $481,561. Contract awarded to J. A. Casson Co. & N. M. Ball Sons, Hayward, $410,196.

NAPA COUNTY—Between Napa and Solano County line, portions about 7.6 miles in length, to be repaired by placing plant-mixed material over the existing bituminous surface. District IV, Routes 8,74, Sections B,A. Parish Bros., Sacramento, $68,860; Lee J. Immel, Berkeley, $69,750; Chas. L. Harney, San Francisco, $71,100; E. A. Forde, San Anselmo, $71,209; Louis Biasotti & Son, Stockton, $73,322; Heafey-Moore Co., Oakland, $74,804; A. Teichert & Co., Sacramento, $80,925. Contract awarded to A. G. Raisch, San Francisco, $63,571.

RIVERSIDE AND SAN BERNARDINO COUNTIES—On Etiwanda Avenue between Mission Boulevard and Valley Boulevard about 3.3 miles to be graded and surfaced with plant mixed surfacing. District VIII. George Herz & Co., San Bernardino, $72,505.50; Bonadiman-McCain, Inc., Los Angeles, $81,601; Griffith Co., Los Angeles, $82,334; Oswald Bros., Los Angeles, $84,562; Harvey Adair Construction Co., El Monte, $98,470. Contract awarded to Matich Bros., Elsinore, $72,505.

RIVERSIDE COUNTY—At points between Indio and Blythe, 33 timber bridges to be repaired. District XI, Route 64, Sections B,C. John Strona, Pomona, $51,380; C. B. Tuttle, Wilmington, $58,057; Dan Caputo, San Jose, $69,068; Ralph A. Bell, San Marino, $69,955; Oberg Bros., Inglewood, $75,200; Carlo Bongiovanni, Hollywood, $75,973; Contracting Engineers Co., Los Angeles, $78,955; Walter H. Barber, San Diego, $82,927; Fred D. Kyle, Los Angeles, $89,276; Flotation Systems, Inc., Los Angeles, $99,917; H. B. Nicholson, Los Angeles, $107,076; A. S. Vinnell Co., Alhambra, $136,332. Contract awarded to F. E. Stearman, Glendale, $42,924.

RIVERSIDE COUNTY—Between 4 miles west of Shavers Summit and 2.9 miles west of Blythe, portions, about 15 miles in length, to be repaired by road mixed method. District XI, Route 64, Sections I,B,C,D,E. Phoenix Construction Co., Bakersfield, $54,009. A. S. Vinnell Co., Alhambra, $58,202; Harvey Adair Construction Co., El Monte, $76,737; Warren Southwest Inc., Los Angeles, $87,232. Contract awarded to Arthur A. Johnson, Laguna Beach, $49,995.

SAN LUIS OBISPO COUNTY—Between San Luis Obispo and 0.8 mile west of Pennington Creek, about 6.5 miles, shoulders and median strip to be graded and bituminous surface treatment applied. District V, Route 56, Section SLO,D. Arthur A. Johnson, Laguna Beach, $41,055; Brown, Doko and Baun, Pismo Beach, $45,778; Granite Construction Co., Watsonville, $52,796. Contract awarded to M. W. Stanfield Co., Los Angeles, $36,317.

SANTA BARBARA COUNTY—Between Surf and Lynden School, about 3.5 miles, imported borrow and plant mixed surfacing to be placed. District V, Route 149, Section A. L. A. Brisco, Arroyo Grande, $48,893. Contract awarded to Brown, Doko and Baun, Pismo Beach, $35,469.

SHASTA COUNTY—Twelve miles east of Redding, a through girder bridge to be constructed across Oak Run Creek. District II, Route 20, Section C. James B. Allen, San Carlos, $10,536; M. A. Jenkins, Sacramento, $11,132; O'Connor Bros., Red Bluff, $11,240; C. C. Gildersleeve, Colusa, $13,810; Louis Angelus Co., Oakland, $14,485; J. Phillip Murphy Corp., San Francisco, $15,637. Contract awarded to Jack Gilmore, Redding, $10,326.

VENTURA COUNTY—On Harvard Street between west city limits of Santa Paula and Main Street, about 2.3 miles to be repaired with plant mixed material. District VII, Route 79. Brown, Doko and Baun, Pismo Beach, $17,435; Vido Kovacevich, South Gate, $17,990; Oswald Bros., Los Angeles, $18,874. Contract awarded to G. W. Ellis, North Hollywood, $16,105.

In Memoriam

Chester A. Potter

On September 17, 1943, Chester A. Potter, Associate Highway Engineer in headquarters office at Sacramento, died suddenly of heart trouble. He was 56 years of age.

"Cap" Potter was one of the old-time construction engineers of the Division of Highways. He joined the State Highway organization as an instrumentman on location in June, 1917, and, with the exception of some eight months' service in the Army during World War I, he continued with the department until his death.

From the start of his employment, "Cap" proved his ability as a highway engineer. His earlier work was all in District I and included both location and construction on the Redwood Highway and the Klamath River Road north of Crescent City. In 1919 he was made Assistant Resident Engineer on prison labor construction in Lake County and two years later became the Resident. In 1926 he was transferred to District X as Resident Engineer on construction in Stanislaus County. A year later he moved to the District III organization, where he remained for over eight years. He served in the capacity of Resident on a variety of construction contracts and from 1931 to 1935 was Maintenance Superintendent in both Marysville and Placerville. He went back to construction and represented the State on numerous highway contracts in District II, including portions of the famous Feather River Highway.

In 1942 his heart began to give him trouble. In November of that year he was forced to give up the active life of a Resident Engineer on construction and was transferred to headquarters office where he worked for the Office Engineer on the securing of priorities and the maze of Federal wartime regulations and restrictions governing highway construction.

"Cap" was one of the Division's most valued Resident Engineers. His experience was wide and varied, covering the supervision of all types of road construction from heavy grading to high type paving. Many of the rising engineers in the Division received the training that put them on their way under the guidance of "Cap" Potter. His discipline of the men who worked under his supervision was firm but kindly. He inspired in them confidence and lasting friendship.

He was born in Greenville, Ohio, and received his education in Anderson, Indiana, and at Earlham College. He leaves a sister, Mrs. Mable Van Hook of Anderson, and two nieces, one in Anderson and the other in Louisville.

State of California
EARL WARREN, Governor

Department of Public Works

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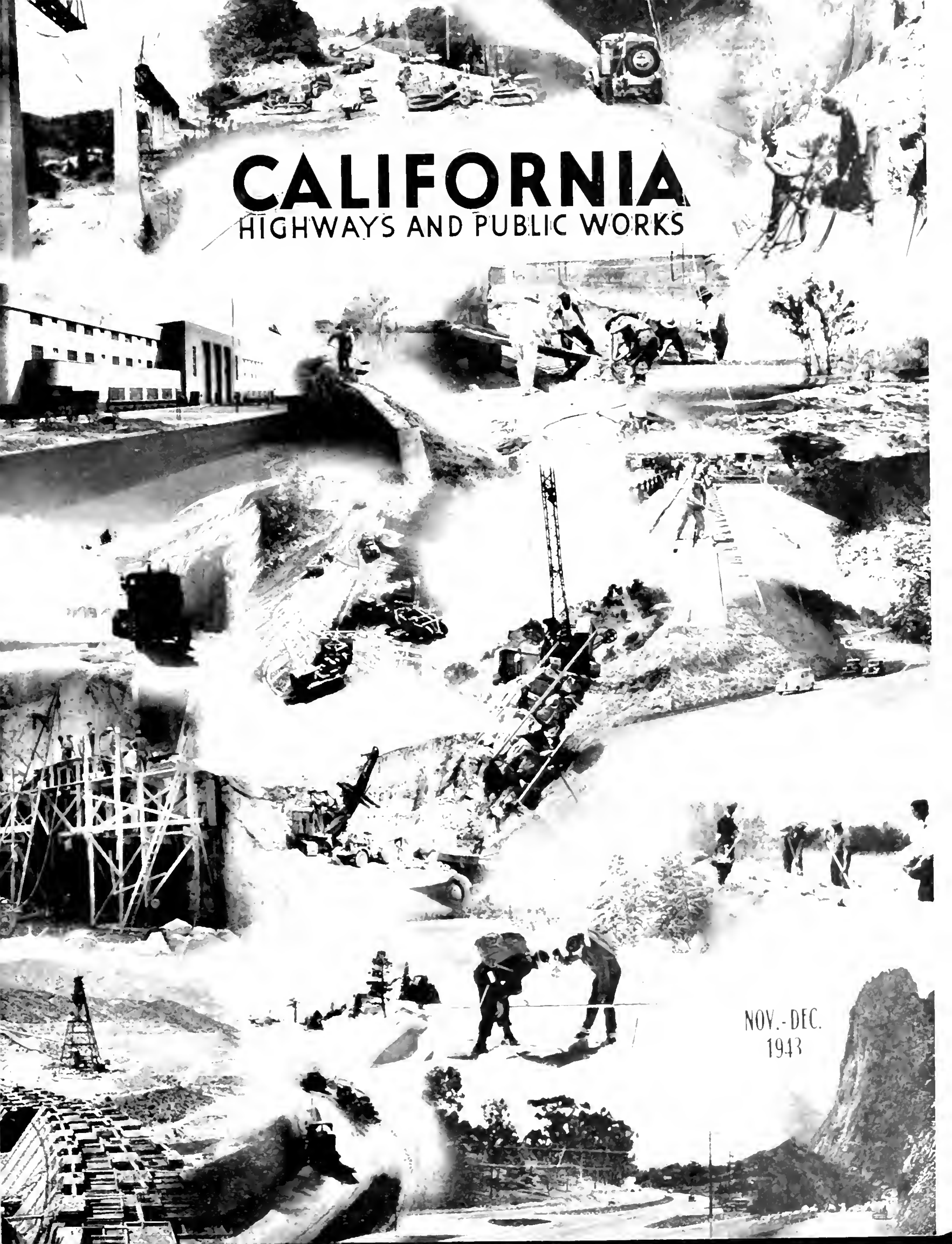

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Official Journal of the Division of Highways, Department of Public Works, State of California

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Engineering and Rights of Way for Postwar Road Program Approved By California Highway Commission

By C. H. PURCELL, Director of Public Works and Chairman of California Highway Commission

An important contribution to Governor Earl Warren's postwar planning was made by the California Highway Commission on November 18th when it approved a $75,000,000 highway construction program submitted to it by George T. McCoy, State Highway Engineer.

This program, designed to be ready for actual building when peace comes, involves 116 projects on the State Highway System, distributed throughout all of the 11 districts of the Division of Highways and balanced between primary and secondary routes and between the northern and southern county groups in accordance with statutory provisions.

While it is conceded that this program will materially aid in solving the anticipated postwar unemployment problem, the fact that California's highway system will be urgently in need of almost complete overhauling, rehabilitation and extension to adequately meet a return to normal conditions is of utmost importance in the conception and carrying out of postwar planning.

The work will include construction or reconstruction of approximately 465 miles of State highways, including extensions and further development of freeways in metropolitan areas in both southern and northern California.*

INCLUDES 76 BRIDGES

Included in this postwar program there are 76 bridges and grade separations of varying sizes and types for which the designs of many are complete or well advanced. Besides these definitely scheduled structures, additional major grade separations will be required for proposed freeway development projects. The number of these additional structures will be dependent upon designs developed as the planning work for the program advances and as the necessary rights of way are determined and acquired.

The last Legislature, under Chapter 564, Statutes of 1943, appropriated the sum of $12,000,000 for surveys, plans, specifications and estimates and for the acquisition of right of way for postwar State highway construction. The Legislature also provided $1,500,000 for planning postwar projects on county roads and city streets.

Including this $12,000,000 the department has unobligated State highway funds totaling $25,000,000 available for the preliminary engineering work and right of way acquisition for the postwar program.

With these available funds, the Division of Highways is proceeding with the preparation of the $75,000,000 postwar highway construction program.

EMPLOYMENT BIG FACTOR

In preparation for its part in the postwar period, the Department of Public Works has given consideration to factors both of general scope and those which apply specifically to the work of the State. Employment is one of the more general phases.

Never before has so great a percentage of industry been withdrawn from civilian manufacture and service and transferred to war production and service. Approximately one-half the persons employed in manufacture today are engaged in war production, and as the Nation reaches the peak of the war effort this percentage may increase.

The period needed for conversion of industry to peace time activities will cause major dislocations of employment. In some sectors a considerable number of the working population will be without employment during the period of retooling.

SERIOUS RETOOLING DELAY

It is estimated that retooling will take anywhere from six to eighteen months and, in some cases, as much as two years. Delay in this retooling may cause serious delay in other conversions. As there will be differences between industries in the time required for conversion, so will there be differences in the rate of recovery in various areas.

As a factor in meeting these conditions during the first two, three, or four years following the war, public works will serve a great need.

One of the important phases of a normal, prosperous economy is found in the activities of the construction industry. Within this industry public works stands as an integral part, and of public works, highway development is the largest unit. Highways are a principal factor in the Nation's transportation system, and upon adequate transportation facilities largely depends the entire economy of the Nation.

While the purpose of public construction is to provide facilities for use of the people, when properly managed, it also appreciably affects employment

LABOR BENEFITS MOST

It is an established fact that expenditure of public funds in construction projects produces not only employment at the site, but passes down through material vendors and equipment manufacturers to mills and mines until from 85 to 95 cents of every dollar is paid out for labor.

Many students of economics also maintain that additional business induced by this chain is equal to from three to three and one-half times the original expenditure.

The evidence is conclusive that well-planned public works do provide a certain amount of cushioning against conditions of unemployment.

It must be emphasized that the primary purpose of any public works is the provision of public facilities—highways, bridges, water and power

(Continued on page 3)

* See tabulations on Pages 10-12.

Overpass structure at cloverleaf grade separation of U. S. 101 and Mission Valley highways in San Diego

Modern Design Features Mark New Highway Construction in San Diego

By E. E. WALLACE, District Engineer

AN important addition to and modernization of the highway system of San Diego was accomplished recently with the completion of the Rosecrans-Mission Valley Highway.

The highway is 3.5 miles in length and provides a 4-lane divided, concrete paved highway, leading to the east and connecting Point Loma with a proposed new freeway at the southerly end of U. S. Highway No. 395, which will extend through Balboa Park directly into the business center of San Diego.

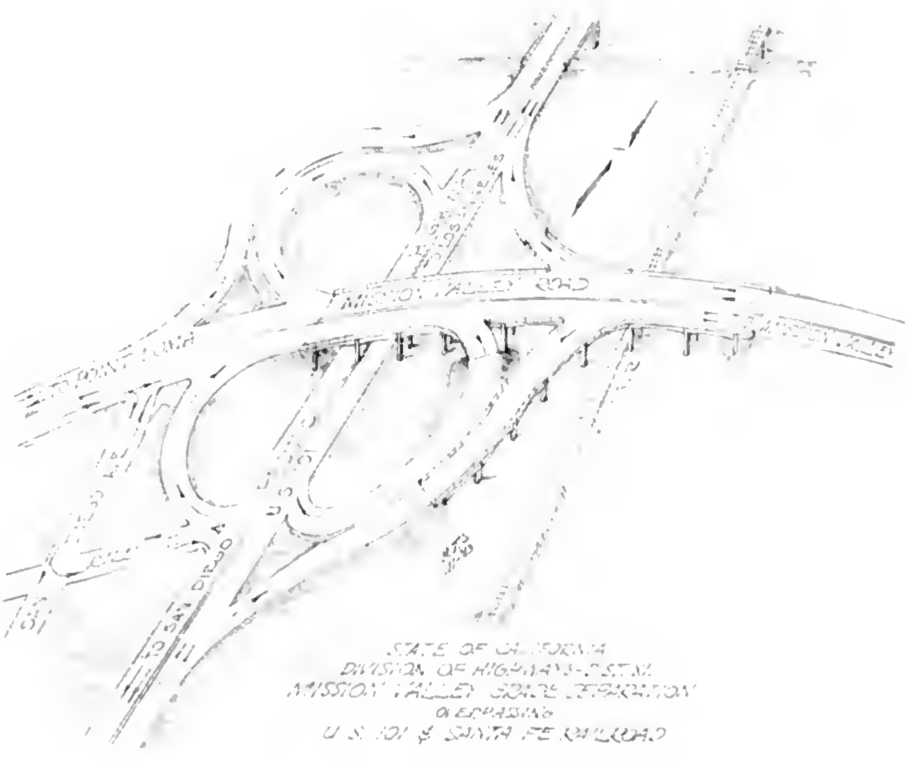
To facilitate the free movement of traffic, the project includes six sets of traffic-actuated signals, together with a channelization of the intersections; a rotary development at the intersection of Frontier and Rosecrans streets, and a modern cloverleaf grade separation crossing over U. S. Highway No. 101 and the Santa Fe Railway main line into San Diego.

ELIMINATE GRADE CROSSINGS

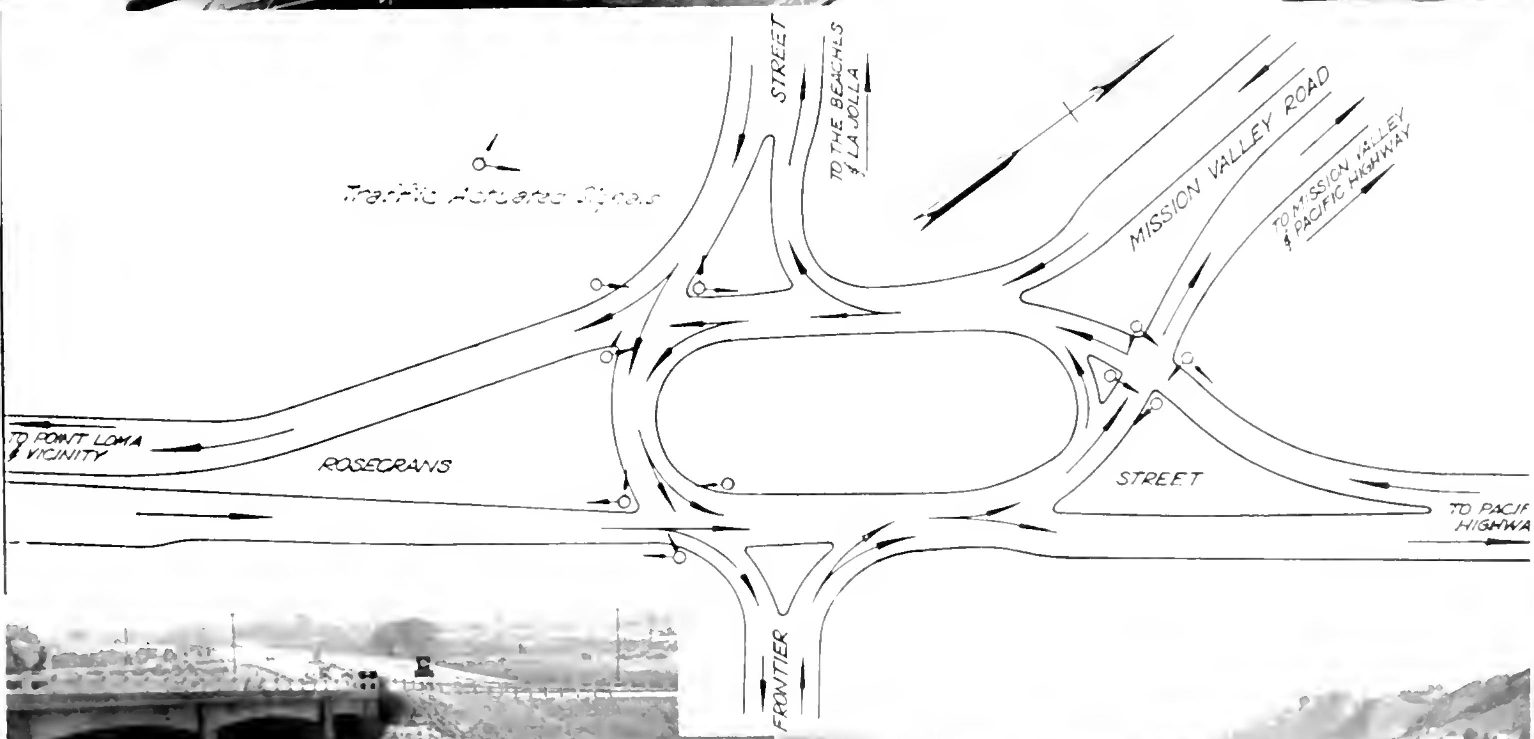
The relocated highway removes a large volume of traffic from the Rosecrans Street railroad grade crossing, where many serious accidents have occurred in the past, and also relieves traffic congestion at the highway grade crossing.

The grade separation is a reinforced concrete, shallow girder type of structure, which was designed by the State Bridge Department with the intention of conserving critical materials and

(Continued on page 7)



Sketch of Mission Valley cloverleaf grade separation overpassing U. S. 101



At top—intersection of Mission Valley Road and Morena Street after widening and channelizing. Center—Rosecrans and Frontier Street traffic circle showing automatic signal installations. Below—two views of the 4-lane divided highway

Spectacular Steel Erection Job On Arroyo Seco Extension Bridge

By P. R. WATSON, Resident Bridge Engineer

SOON after the completion of the Arroyo Seco Freeway from the City of Pasadena to a connection with the North Figueroa Street Extension just north of San Fernando Road in the City of Los Angeles it became apparent that the North Figueroa Street Extension with its tunnels through the Elysian Hills was no longer adequate to carry the two-way traffic imposed upon it and that steps must be taken immediately to provide a previously planned parallel highway to relieve this traffic congestion.

The proposed highway will extend the Arroyo Seco Parkway southerly an additional 1.8 miles parallel to and on the westerly side of the North Figueroa Street Extension. This extension included a thorough cut through the Elysian Hills and the construction of six grade separations, the largest of which is the Los Angeles river bridge which extends over San Fernando Road, the Los Angeles river, the tracks of the Southern Pacific Railroad on both banks of the river, and Riverside Drive.

Moving this 146 foot girder weighing 82 tons closed city streets three hours

The Los Angeles river bridge now under construction consists of five continuous reinforced concrete spans and three continuous steel plate girder spans on reinforced concrete abutments and piers. The concrete piers and abutments are skewed to meet the river channel and existing improvements. The south abutment forms part of the retaining wall supporting the south approach and the inbound Riverside Drive ramp, while the piers on each side of the Los Angeles river form a part of the river protection work.

This 70 ton member had to be swung 100 feet in the air

HUGE STEEL SPANS

The piers, abutments, and the five northerly reinforced concrete spans of approximately 75 feet each of this structure were built by WPA forces under the sponsorship of the State. The structural steel spans were constructed by the Bethlehem Steel Company under a State contract.

The steel portion or southerly end of this bridge consists of three plate girder spans having a total length of 488 feet 6 inches measured along the centerline of the bridge. The girder spans vary in length; that over the Southern Pacific tracks on the north bank is 102 feet 6 inches; the span across the river is 200 feet; the one over Riverside Drive and the Southern Pacific tracks on the south bank is 197 feet 1 inch in length at the east girder, 163 feet 7½ inches at the center girder, and 150 feet 2¼ inches at the west girder, the variation in girder lengths being due to the difference in skew in the pier and south abutment.

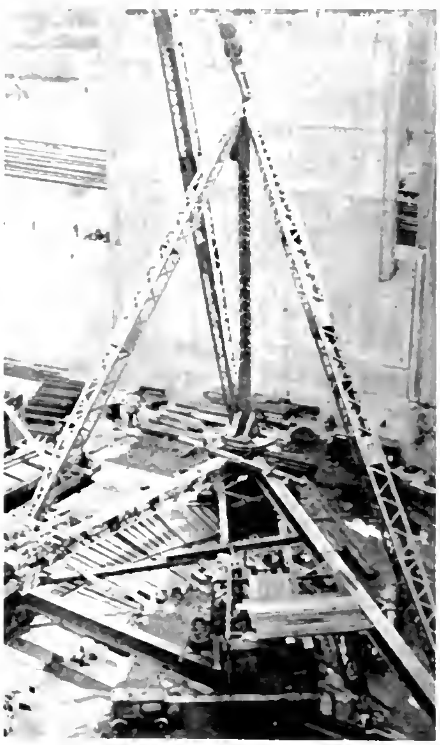
Each span consists of three plate girders, 22 feet on centers, which support the floor system. The main girders, which are approximately 100 feet above the river floor, are 302 feet 6 inches in length and, in addition to spanning the 200 feet across the river, provide cantilever extensions into the adjacent spans. These cantilevers extend to approximately the 1/3 point of each end-span and are joined to the corresponding simply supported end-girders by means of a link and pin assembly which also acts as an expansion joint.

The structural steel was assembled and fabricated at the Bethlehem Steel Company's plant at Chicago, Illinois, and shipped to the site by rail. The 300-foot main girders were shipped in three sections and connected by field splices at the site after being hoisted into place.

SPECTACULAR GIRDER PLACEMENT

Probably the most spectacular feature of the construction of this bridge was that of raising the main girder sections to a position approximately 100 feet above the paved invert of the river. This operation was performed with an 85-ton stiff-leg traveler derrick. This derrick was one of four built by the Bethlehem Steel Company for use in the erection of the George Washington Bridge in New York. It was moved on five low-bed trucks to the Los Angeles river bridge site and

Steel construction on bridge section fast approaching completion



Stiff leg derrick did the work

set up on the paved invert of the river channel.

The derrick, as set up, had the longer leg pivoted, the estimated upward thrust of 25 tons being taken by a steel column acting against the lower flange of the adjoining Figueroa Street Bridge. Under the mast at the end of the short leg were trucks which operated on a mono-rail track constructed on an 80-foot radius.

The location of the derrick was such that it was unnecessary to disturb the pivoted end of the derrick, all changes in the location of the mast for setting the steel sections being made by moving the mast along the mono-rail.

This changing of the mast locations was made by sidelines fastened to eyebolts in the piers, power being furnished by a 35 H. P. donkey engine. When the required position was obtained, the mast and end of the short leg were blocked up thereby removing the load from the mono-rail during the heavy lifts.

85-TON STIFF LEG DERRICK

The 85-ton derrick was operated by a three-drum hoist powered by a 175 H. P. gas engine. The boom of the derrick was 125 feet in length. The load line consisted of 12 parts of 7/8-inch steel cable. The topping lift or line for raising and lowering the boom was of 22 parts of 7/8-inch cable which alone required approximately 3,000 feet of line.

The sections of the main girders were lifted directly from freight cars spotted on the tracks of the Southern Pacific on the south side of the river and then lowered to the river bottom where contact surfaces were cleaned and girders turned over when required. The mast of the derrick was then shifted to the required position and the girders then hoisted in place

New bridge parallels existing structure

and pinned and bolted. The girder sections varied in weight from 56/72 tons.

SWINGING 82-TON GIRDER

The three south end girders, which were out of reach of the big derrick, were set by an entirely different procedure. These girders were unloaded from the cars at the river station track of the Southern Pacific onto heavy house-moving equipment by a trucking concern and brought to the site over city streets to Figueroa Street, which necessitated the closing of the Figueroa Street Extension for three hours during time each girder was brought in.

The longest girder was 146 feet in length and weighed 82 tons. These girders were picked up by 60-ton and

(Continued on page 20)

Grade Separation Eliminates Traffic Hazards to Shipyard Workers

By W. A. RICE, Resident Engineer

SHORTLY after war was declared, the United States Maritime Commission directed the construction of extensive shipbuilding facilities at Sausalito on the north shore of San Francisco Bay. This war plant is known as Marinship and employs many thousand workers in the construction of cargo ships and tankers.

As the construction of the shipyard progressed, and when production of ships began, thousands of new workers migrated into this area where housing facilities were already at a premium.

To relieve this situation, the Marin Housing Authority was created, and, under its supervision, a new city of several thousand population grew up on the marsh lands west of Highway 101, at the foot of Waldo Grade and about a mile north of Marinship.

This site was chosen because its location afforded shipyard workers homes within walking distance of work, thereby saving gasoline and tires.

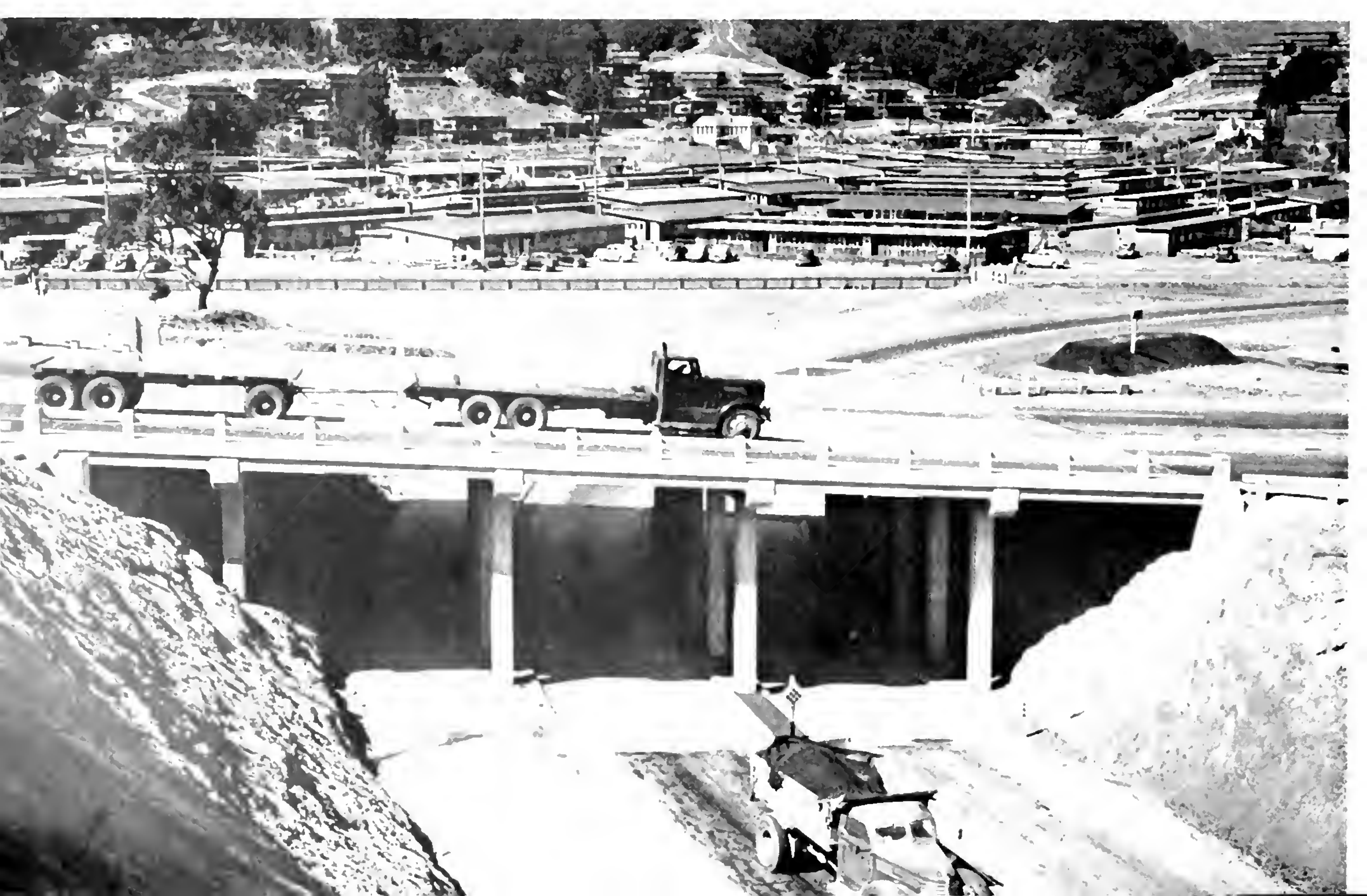
This pedestrian traffic, together with an abnormal increase in trucking and commuter traffic, both by private car and by bus, to either the shipyard or to San Francisco caused a terrific congestion at the Waldo intersection, particularly at shift changing times.

Traffic at Waldo intersection was segregated by means of channel islands, but this method of caring for the increased activities soon proved inadequate and it was decided to construct a modified clover leaf type of intersection. This construction involved an undercrossing which was built approximately eight hundred feet south of the existing channelized intersection.

A contract was awarded to N. M. Ball Sons, of Berkeley, for the construction of this undercrossing together with all incidental work connected with the new grade separation structure. This work involved the construction of a temporary detour around the site of the structure; grading and paving with plant mixed surfacing of the required new roadways together with approaches to the deck of the structure; a new roadway connection to Marin City; pedestrian sidewalks; new curbs, and elimination of the existing channelization.

Work was begun on March 31, 1943, and the undercrossing was rushed to completion, being opened to traffic of Highway 101 on the morning of July 7, 1943. The detour was then removed and all other work was completed by August 31, 1943.

Looking through underpass at grade separation of U. S. 101 and State Sign Route No. 1 at Waldo showing Marin City in background



View of Waldo grade separation of U. S. 101 and Marin City road. Bridge structure carries 5-lane divided highway

The bridge is a reinforced concrete slab structure, consisting of four 19-foot spans and one 13-foot span on concrete bents. It provides two 14-foot traffic lanes and a 10-foot sidewalk beneath the structure. The deck accommodates a 25-foot roadway to northbound traffic and a 37-foot roadway for southbound traffic, separated by a 4-foot curbed division strip.

Upon the completion of the project, traffic may now flow without interruption from northern points to San Francisco, Marinship or Marin City; from San Francisco to northern points or Marinship; from Marinship either north or south; and finally it provides the multitude of worker-pedestrians safe passage beneath the heavily traveled roadway. This grade separation structure and appurtenances also serves the Town of Sausalito.

The project, as a whole, was designed to obtain the desired results with the use of a minimum of critical materials. For reinforcing steel in the structure, salvaged railroad rails were rerolled and used. The rails had previously been purchased by the

(Continued on page 15)

Modern Design in San Diego Highway Construction

(Continued from page [illegible])

utilization of the lowest grade line possible. It was necessary to provide for a four foot raise in the grade of the Santa Fe tracks which will be necessary at some future date in order to properly provide for flood control of the San Diego River.

The approach ramps, which provide access to U. S. Highway 101 from the separation structure, were necessarily somewhat restricted because of the limitations which were imposed by the proximity of the railroad on the east and the San Diego River on the north.

A portion of the highway traverses a low tideland flat which required importation of a large amount of select material for the roadway subgrade and embankment. The crossing of this low flat area presented an expensive drainage problem.

A storm drain 2,900 feet in length was installed which will carry the storm waters to a connection with a large concrete sump and pumping system, which was installed by other interests, and from which the storm waters are pumped through the south levee of the San Diego River. A portion of the drain was installed below tidewater elevation and in wet excavation and a system of well points was used to dewater the trench.

From Morena Boulevard easterly the grade of the new highway was established high enough to clear future maximum floods in the San Diego River, and portions of the embankment were heavily riprapped with rock to withstand the flood erosion.

Wide rights of way were secured to provide adequate width for the divided highway and for possible future landscaping.

Concrete pavement was designed with thickened edges and was thickened at the expansion joints, and the usual steel reinforcement was eliminated in order to conserve a critical material.

The project was approved as an access highway.

Equipment working on new grade of relocated Franklin Canyon highway. Channel change of Franklin Creek below level of old road shown at left

First Unit of Reconstruction on Franklin Canyon Highway Completed

By F. W. MONTELL, Resident Engineer

IN order to provide more modern traffic facilities for the industrial areas of Martinez and Pittsburg as well as local traffic, the Division of Highways, on September 4, 1942, awarded a contract to N. M. Ball Sons for the reconstruction of a portion of State Highway Route 106 in Franklin Canyon, Contra Costa County. The project was duly approved by the Federal Government as necessary to the war effort and recently completed.

Since the funds available were inadequate to cover the cost of reconstruction throughout the canyon, the section was selected in order to cover as much as possible of the worst existing road conditions in respect to alignment, grade, drainage, maintenance cost and traffic service.

The greatly increased traffic due to the war effort made this improvement necessary, especially to eliminate several old wooden bridges on poor alignment.

CHANNEL CHANGES INVOLVED

The existing road was constructed by Contra Costa County, mainly in the years from 1918 to 1922, on alignment and grades which required a minimum of excavation and embankment, and consequently had heavy grades and sharp curves.

The new alignment, 1.9 miles in length, lying in the narrow floor of the canyon, required the construction of five large unreinforced concrete arch culverts totaling 1,330 feet under the main roadway and extensive channel changes to provide a waterway for Franklin Creek. Numerous smaller structures were necessary to provide drainage and access to private property adjacent to the project.

Due to wartime shortages of critical materials, unreinforced concrete structures were installed throughout the project. Broken concrete from the old pavement was utilized in the construction of rubble masonry walls and riprap lining of the channel to prevent erosion of the creek banks during peak storms.

A precipitation of four to five inches in a period of 24 hours and one inch per hour for short periods has been recorded in this area.

FOUR-LANE HIGHWAY PLANNED

The project is designed for stage construction, right of way being acquired for the ultimate development to a four-lane divided highway.

The new construction consisted of a 22-foot width of armor coat and 8-foot penetration treated shoulders placed on a one-foot minimum thickness of select material and eight inches of crusher run base. Plant-mixed surfacing was provided for the gutters on grades of 3 per cent or over.

Curvature was reduced from 414 degrees on the present road to 174 degrees on the new construction, and the minimum radius was increased from 239 feet on the existing road to 1,000 feet on the new construction.

Construction operations were necessarily suspended from December 14, 1942, to May 3, 1943, as the new work required the construction of extensive channel changes and numerous drainage structures that will obliterate the existing road. It was not considered advisable to attempt the heavy grading work under traffic during the rainy season.

The terrain traversed is an open valley at the upper end and a steep-sided canyon at the lower end, with occasional unstable formations in cut areas. As a result, some slides were encountered.

The following were major contract items:

180,000	cu. yds. roadway excavation
36,000	cu. yds. trench and channel excavation
5,000	cu. yds. structure excavation
3,500,000	sta. yds. overhaul
1,500	cu. yds. riprap
750	cu. yds. rubble masonry
1,610	cu. yds. portland cement concrete
29,000	tons imported borrow
1,620	lin. ft. unreinforced concrete pipe
6,630	lin. ft. perforated metal pipe
173	tons liquid asphalt
1,370	tons screenings.

Labor shortage materially affected the progress of the work, which was completed October 23d last.

Excavating cut for new alignment. Old road shown at left

Dragline placing 36-inch reinforced concrete drainage pipe

Postwar Road Program Approved by Commission

(Continued from page 1)

projects and buildings to serve public needs.

CONSTRUCTION AT STANDSTILL

With the efforts of the Nation bent upon successful prosecution of the war and production of war needed equipment and facilities, public construction programs are at a standstill. Normal functions of the State Department of Public Works have been curtailed to the point of holding what we have by maintenance and repair.

Highway development through new construction is static, with the exception of the building of Federal Access Roads and structures requested by the military and financed with Federal funds. In the case of this type of Federal projects, the Division of Highways acts merely in the capacity of engineering and construction agent.

Other field activities of this branch of the department have been reduced to maintenance and reconditioning roadway surfaces and repair of bridges.

Under this cessation of construction and reconstruction, the State Highway System is deteriorating through obsolescence, limited maintenance and the increased rate of damage resulting from large volumes of wartime heavy trucking. The longer the war lasts, the greater will be the deterioration of State roads. California will enter the

(Continued on page [illegible])

Detail of Projects Approved for Post War Program

County	Route	Location	Miles	Type of improvement
Alameda	69	6th and Oak Streets to High Street in Oakland	3.7	Grade and pave, multiple lane divided
Alameda	69	South city limits of Oakland to High Street	3.7	Grade and pave, 6-lane freeway
Alameda-Contra Costa	69	North city limits of Emeryville to Junction Routes 69 and 14	5.1	Grade, pave and resurface, 2 lanes added
Alameda	107	Alameda Creek at Brightside Bridge and approaches		Bridge and approaches
Butte	3	[illegible] 0.4 Mile South of Fagan	5.0	Grade and pave
Contra Costa	14	Junction Routes 69 and 14 to north city limits of Richmond	1.5	Grade and pave, 4-lane freeway, and grade separation
Contra Costa-Alameda	69	North city limits of Emeryville to Junction Routes 69 and 14	5.1	Grade, pave and resurface, 2 added lanes
Del Norte	71	Route 1 to Smith River	5.0	Grade and surfacing
El Dorado	11	3 miles east of [illegible] miles east of El Dorado	5.2	Grade and surfacing
El Dorado-Placer	65	South Fork American River Bridge and Approaches	0.2	Bridge and approaches
Fresno	4	[illegible] Overhead to [illegible] Avenue	2.1	Grade and pave, 4-lane freeway
Fresno	4	South city limits of Fowler to [illegible] Overhead	6.3	Grade and pave, 4-lane divided
Fresno	4	South city limits of Kingsburg to Selma	4.7	Grade and pave, 4-lane divided
Fresno	4	[illegible] to San Joaquin River	7.2	Reconstruct to 4-lane divided
Fresno	41	San Joaquin River [illegible] Bridges		Bridges and approaches
Fresno	125	[illegible] Canal Bridge	1.9	Reconstruction and bridges
Fresno	125	[illegible]	2.1	Reconstruction
[illegible]	45	[illegible] Sacramento River Bridge	0.5	Grade, surfacing and bridge
Humboldt	1	[illegible] NWPRR Overhead [illegible] Bridge	5.6	Grade, surfacing and bridges
Humboldt	20	[illegible] Bridges		Bridges and approaches
Humboldt	20	Mad River Bridge		Bridge and approaches
Humboldt	46	Klamath River [illegible] Bridge		Bridge and approaches
Imperial	26	[illegible]	12.5	Reconstruct to 4-lane divided
Imperial	26	[illegible] Beach	14.7	Resurfacing and structures
Kern	4	[illegible] Bakersfield	3.2	Reconstruct to 4-lane divided
Kern	4	[illegible] Bakersfield [illegible]	3.2	Reconstruct to 4-lane divided
Kern	4	[illegible]	5.5	Reconstruct to 4-lane divided
Kern	4	Bakersfield [illegible]	3.8	Reconstruct to 4-lane divided
Kern	23	[illegible]	16.7	Resurfacing and structures
Kern	23	[illegible]	5.2	Resurfacing
Kern	58	Mojave [illegible]	10.2	Reconstruction
Kern	58	[illegible]	6.5	Grading, resurfacing and structures
Kern	58	[illegible] 4 bridges	13.6	Grading, surfacing and structures
Kern-[illegible]	139	[illegible]	15.6	Oiling and structures
Kings	125	[illegible]	1.5	Reconstruction
[illegible]	53	[illegible] Creek Bridge		Construct bridge
[illegible]	21	[illegible] Route 29 [illegible] Overhead	4.5	Grade and pave, construct overhead
[illegible]	29	[illegible]	7.6	Grade and pave
Los Angeles	2	[illegible] Grade Separation	1.6	Grade, pave and structures, 8-lane freeway
Los Angeles	2	[illegible] Bridge [illegible] Avenue	4.1	Grade, pave and structures, 8-lane freeway
Los Angeles	2	[illegible] Street Bridge	4.2	Grade, pave and structures, 6 and 8-lane freeway
Los Angeles	2	[illegible] Highway Boulevard	3.4	Grade, pave and structures, 8-lane freeway
Los Angeles-[illegible]	2	[illegible] Park [illegible]		Reconstruction
Los Angeles	4	[illegible] County Boundary [illegible]		Reconstruct to 4-lane divided

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County	Route	Location	Miles	Type of improvement
os Angeles	19	Route 77 to Pomona	0.7	Reconstruct to 4-lane divided
os Angeles	60	Latigo Canyon to Winter Canyon	0.6	Reconstruct to 4-lane divided
os Angeles	165	Harbor Freeway from Adobe Street to Fifth Street	1.2	Grade and pave 6-lane freeway
os Angeles	168	Huntington Drive to Colorado Street	1.1	Grade and pave 4-lane divided
os Angeles	173	Olympic Boulevard, Bundy Drive to Lincoln Boulevard	2.3	Grade and pave 4-lane divided
os Angeles	174	Los Angeles River Bridge and Approaches	0.7	Bridge and approaches 4-lane divided
os Angeles	178	Lakewood Boulevard to South County Boundary	5.0	Resurfacing
Marin	1	Ignacio to North County Boundary	8.6	Grade and pave 4-lane divided
Mendocino	1	Red Mountain Creek to Piercy, Sidehill Viaduct	4.9	Grade, surfacing and structures
Mendocino	1	Forsythe Creek to Ridgewood Summit, Forsythe Creek Bridge	8.2	Grade, surfacing and bridge
Mendocino	1	Rock Creek Bridge		Bridge and approaches
Mendocino	16	Dooley Creek Bridge		Bridge and approaches
Mendocino	56	Alder Creek Bridge		Bridge and approaches
Mendocino	56	Mitchell and Hare Creeks Bridges		Bridges and approaches
Merced	4	Black Rascal Canal to Bubach Station	3.2	Reconstruction to 4-lane divided
Modoc	73	South Fork of Pit River Bridge		Bridge and approaches
Mono	23	Rock Creek to Casa Diablo	18.6	Resurfacing and structures
Monterey	2	2 miles south of Salinas to Salinas	1.9	Reconstruct to 4-lane divided
Monterey, San Benito	2	Santa Rita to Peston, Grade	11.0	Reconstruct to 4-lane divided
Monterey	56	Del Monte Junction to Seaside Junction	2.6	Reconstruct to 4-lane divided
Nevada, Sierra	38	[illegible] mile north of Farad to [illegible] mile south of Nevada State Line	3.0	Reconstruction
Orange	2	Broadway to First Street in Santa Ana	2.4	Grade, pave and structures, 6-lane freeway
Orange	2	Doheny Park to Trabuco Creek, Drainage		Drainage correction
Orange	60	Laguna Beach to Dana Point	9.0	Reconstruct to 4-lane divided
Placer	3	Roseville Underpass and Approaches	0.7	Construction underpass and approaches
Placer	17	Junction new Route 37 in Auburn to U. S. General Hospital, SPRR Grade Separation	3.3	Grade, surfacing and grade separation
Placer	37	Nevada Street in Auburn to 0.5 mile east of Auburn, SPRR Grade Separation	2.0	Grade, surfacing and grade separation
Placer, El Dorado	65	North Fork American River Bridge and Approaches	0.2	Bridge and approaches
Riverside	19	1 mile east of Mira Loma to 3.0 miles west of Riverside	5.2	Grade and pave 4-lane divided
Riverside, San Bernardino	19	Los Angeles County Line to 1 mile east of Mira Loma	12.2	Grade and pave 4-lane divided
Riverside	64	4 miles west of Blythe to State Line	7.3	Grade, pave and structures
Sacramento	3	North Sacramento Viaduct to [illegible] mile east of Ben Ali	4.1	Grade, surfacing and structures, 4-lane divided
Sacramento, Solano	53	Sacramento River at Rio Vista Bridge		Bridge and approaches
San Benito, Monterey	2	Santa Rita to Peston, Grade	11.0	Reconstruct to 4-lane divided
San Bernardino, Riverside	19	Los Angeles County Line to 1 mile east of Mira Loma	12.2	Grade and pave 4-lane divided
San Bernardino	26	State Street to East City Limits of Redlands	2.8	Reconstruct to 4-lane divided
San Bernardino	26	Ontario to Colton	17.1	Reconstruct to 4-lane divided
San Bernardino	207	Route 190 to Route 43 (City Creek Road)	16.4	Grade and pave
San Diego	77	"A" Street to [illegible] mile north of San Diego City Limits	6.9	Grade and pave 4-lane divided
San Diego	77	½ mile north of city limits to Poway	13.5	Grade and pave
San Francisco	68	In San Francisco, South City Limits to Fifth Street	5.2	Grade and pave 8-lane freeway
San Joaquin	4	Jct. Mariposa Road south of Stockton to Calaveras River	5.5	Grade and pave 4-lane divided
San Joaquin	4	Calaveras River to Lodi	3.0	Reconstruct to 4-lane divided

DETAIL OF PROJECTS APPROVED FOR POST WAR PROGRAM BY CALIFORNIA HIGHWAY COMMISSION NOVEMBER 18, 1943

Mistakes of Bidders in Submitting Proposals for State Highway Work

By RICHARD H. WILSON, Office Engineer

UNDER provisions of the State Contract Act, major construction operations of the California Division of Highways are conducted in conformance with the democratic practice of competitive bidding.

For the protection of the State and its interests the procedure of bidding is governed by various legal provisions, rules and regulations.

These include such conditions as the requirement of prequalification of contractors as to financial standing and experience before they may bid upon State highway work, the estimated cost of which is in excess of $15,000; the requirement that all contractors be licensed by the State, and that all bids be accompanied by a guaranty in an amount of at least 10 per cent of the bid. The latter provision is to insure that the bidder will accept the contract if it is awarded to him and will furnish bonds for faithful performance of the work and for payment of all labor and materials in connection with it.

While the majority of contractors submitting bids for State highway work are thoroughly familiar with bidding procedure, the number of irregularities which occur has made it advisable to call the attention of bidders to the more common mistakes, omissions and irregularities which jeopardize their bids from consideration for award of contracts.

STATE LICENSE REQUIRED

The basic requirement for a contractor operating in California is that he be properly licensed by the Contractors' State License Board. Failure to secure such a license, of course, precludes operation in the State as a contractor. Many contractors, however, are negligent in renewing their licenses during the thirty day renewal period preceding July first of each year. On several occasions this negligence has resulted in the required rejection by the Department of Public Works of otherwise acceptable bids for proposed highway construction.

Another oversight which has cost several contractors the award of State highway contracts is change of the status of a firm without notifying the Contractors' License Board of the change. Such instances include change in the partners of a copartnership, or of an individual taking in a partner. In one or two instances a corporation has been dissolved and members of the firm have continued to operate under the old name but as a copartnership, without securing a new license. Similarly two or more contractors desiring to bid on a project as coadventurers, frequently neglect to secure a joint-venture license.

One trouble-causing frailty which seems to apply only to contractors operating as individuals is the practicing of using varying forms of a firm name. These contractors either can not decide upon a name style under which they wish to operate or they forget the style which they have previously used. To be perfectly safe, names appearing on the license, on the prequalification statement and as the signature on the proposal should agree in all details.

JOINT BIDDER CONDITIONS

As the prequalification of bidders on the basis of the statement of financial condition and experience is required before a proposal will be issued by the Division of Highways, little difficulty is encountered from this phase of bidding requirements. The principal source of trouble in this regard occurs when two or more bidders decide to bid jointly on a proposed contract and neglect to file with the Division of Highways an affidavit of intention to bid on a joint-venture basis.

Bidding requirements provide that a proposal may be submitted only by the bidder to whom it was issued. Proposal forms are serially numbered to insure conformance with this requirement. As a bid submitted by two or more contractors jointly is on a different basis than one submitted

BIDS AND AWARDS

OCTOBER, 1943

ALAMEDA COUNTY—Across Cypress Street at 32d Street in the city of Oakland, a pedestrian overpass to be constructed. District IV, Route 69. D. W. Nicholson Corp., San Leandro, $4,622; Dan Caputo, San Jose, $4,867; James B. Allen, San Carlos, $5,523; Lee J. Immel, Berkeley, $6,442; Carlton C. Gildersleeve, Willows, $9,910. Contract awarded to A. A. Tieslau & Son, Berkeley, $4,449.

ALAMEDA COUNTY—At the South Verona Underpass, between Sunol and Dublin, about 0.4 mile to be graded and Portland cement concrete pavement and plant-mixed surfacing to be placed. District IV, Route 107, Section B. A. A. Tieslau & Son, Berkeley, $28,608; Louis Biasotti & Son, Stockton, $23,089; Piazza & Huntley, San Jose, $31,802; Lee J. Immel, Berkeley, $32,443. Contract awarded to Dan Caputo, San Jose, $22,848.

CONTRA COSTA COUNTY—At Glen Frazer about 3 miles west of Martinez, about 0.1 mile, a reinforced concrete pipe to be placed and related work to be performed. District IV, Route 106, Section A. McGuire and Hester, Oakland, $22,642; Kiss Crane Co., El Cerrito, $22,629; Peter Sorensen, Redwood City, $26,908; A. A. Tieslau & Son, Berkeley, $29,479; Louis Biasotti & Son, Stockton, $34,028; Lee J. Immel, Berkeley, $34,448; M. J. Lynch, San Francisco, $36,103. Contract awarded to Carl N. Swenson Co., San Jose, $18,668.

CONTRA COSTA COUNTY—On Harbor Street in and adjacent to Pittsburg, about 0.4 mile to be graded and surfaced with plant-mixed surfacing on crusher run base. District IV, Harbor Street. Lee J. Immel, Berkeley, $19,028; C. M. Syar, Vallejo, $19,156; A. A. Tieslau & Son, Berkeley, $19,323; Claude C. Wood, Lodi, $20,322. Contract awarded to Louis Biasotti & Son, Stockton, $16,534.

CONTRA COSTA COUNTY—On Cutting Boulevard between Garrard Boulevard and 14th Street in Richmond, about 1.5 miles, constructing asphalt concrete pavement on the existing pavement and newly constructed crusher run base. District IV, Cutting Boulevard. A. A. Tieslau & Son, Berkeley, $74,233. Contract awarded to Lee J. Immel, Berkeley, $70,715.

LOS ANGELES-ORANGE COUNTIES—Between Colorado Street and 0.10 mile south of San Gabriel River, about 1.4 miles long, constructing plant-mixed surfacing on untreated rock base. District VII, Route 60, Sections F, Long Beach, SIB. Griffith Co., Los Angeles, $79,712; Sully Miller Contracting Co., Long Beach, $85,860; J. E. Haddock, Ltd., Pasadena, $88,000; Ansco Construction Co., Long Beach, $90,860. Contract awarded to Owl Truck & Construction Co., Compton, $71,884.

PLACER-EL DORADO COUNTIES—Across North Fork American River 2½ miles east of Auburn. Repair existing suspension bridge. District III, Route 65, Section A. J. Philip Murphy Corp., San Francisco, $12,380; Markwart Co., Sacramento, $12,495; C. C. Gildersleeve, Willows, $14,404; M. A. Jenkins, Sacramento, $14,510; James H. McFarland, San Francisco, $14,080; E. E. Smith, Holt, $16,520. Contract awarded to Kiss Crane Co., El Cerrito, $11,940.

PLACER COUNTY—Between State Highway Route 17 and U. S. Hospital, north of Auburn, about 1.2 miles to be graded and surfaced with plant-mixed surfacing. District III. Contract awarded to A. Teichert & Co., Sacramento, $88,477.

SAN DIEGO COUNTY—Between San Diego River and La Jolla Junction, portions only, a length of about 4.8 miles to be repaired with plant-mixed material. District XI, Route 2. Daley Corp., San Diego, $36,294; R. E. Hazard & Sons Contracting Co., San Diego, $36,436; Griffith Co., Los Angeles, $37,077. Contract awarded to V. R. Dennis Construction Co., San Diego, $33,597.

SOLANO COUNTY—In Vallejo Township, about 4.7 miles of existing bus routes to be graded and paved with plant-mixed surfacing and asphalt concrete. District X, Bus Routes Project No. 1. C. M. Syar, Vallejo, $88,223; Lee J. Immel, Berkeley, $95,910; Louis Biasotti & Son, Stockton, $96,093; E. A. Forde, San Anselmo, $108,682. Contract awarded to Piazza & Huntley, San Jose, $87,874.

by any one of the coadventurers individually it is necessary that the proposal be issued to the bidders jointly. This is accomplished by the filing with and acceptance by the Division of Highways of the joint venture affidavit. The division furnishes these affidavit forms on request.

Many contractors have been disappointed in not being permitted to submit a bid on some particular project because their prequalification statement has expired or there is not sufficient time between the filing of their statement and the date of bid opening.

As it requires some study on behalf of both auditors and engineers to arrive at a bid rating for a prospective bidder, the State requires that prequalification statements be filed at least five days prior to the date of opening bids on any project for which a bidder wishes to submit a proposal. The department notifies prequalified contractors by mail of the expiration date of the prequalification in ample time for them to prepare and submit a new statement before the current one expires.

MISTAKES IN BID PRICES

In the course of many years of bid opening it has been observed that the greatest number of mistakes and errors made by bidders occur in the body of the proposal and on the proposal signature page.

The most frequent mistake appears to be that of incorrectly writing the words of a unit price bid on some item. Requirements stipulate that in discrepancies between words and figures, the words shall prevail. This type of mistake can be attributed only to lack of care in preparation of the bid, for writing a unit bid price in words is no more difficult than writing in words the amount of a check.

The writing of fractions of a cent seems to cause considerable difficulty, particularly when written as a decimal. Bidders frequently write the decimal in terms of dollars but use the word "cents" or in terms of cents and use the word "dollars." This mistake changes the value of the unit price bid and often runs the extension into fantastic figures.

Omission of the words "dollars" or "cents" in writing in the unit bid price frequently leads to an ambiguity as to the intent of the bidder and makes interpretation difficult.

Alteration of the text of items or qualification of the special provisions are sometimes cause for disqualification of a bid. Comparison of bids submitted for State highway work must be made entirely on the basis of the terms of the special provisions and a bid submitted upon any other basis is not comparable to the bids submitted on the special provisions as they are written and therefore can not be considered.

Bidders sometimes attach a letter to their proposals setting forth qualification of one or more items. If the proposal refers to this letter or the letter states that the bid is submitted subject to qualifying terms, the attorneys for the department have ruled that the bid is thereby qualified and can not be considered.

Nor can incomplete bids be given consideration. Bidders unfamiliar with State highway practice sometimes will submit proposals on only certain items, neglecting to bid on the entire proposed work. As the Division of Highways is interested only in contracting for the entire project as set forth in the special provisions such proposals are of no value.

In several instances bidders have detached the special provisions from the proposal and submitted only the sheets showing the unit bid prices and signature page. As the special provisions are an integral part of both the proposal and contract such detached bids are incomplete and can not be considered.

BIDS MUST BE SIGNED

Bidders occasionally get their proposals into difficulty by filling in the items in contract form instead of in the proposal form. The contract form is placed in the back of the special provisions and proposal booklet so that the contract will be a complete document at the time of award. It also shows the bidder just what the form of contract will be, should he be low bidder and the contract be awarded to him.

Proposals submitted for proposed State highway work may be classed as legal documents and as such it is necessary that they be properly signed by the bidder so that there may be no question as to their validity.

An unsigned proposal obviously can not be given consideration, even though the name of the intended bidder appears elsewhere in the proposal. In accepting a proposal for consideration the State must be in a

BIDS AND AWARDS

OCTOBER, 1943 (Continued)

SOLANO COUNTY—In Vallejo Township, about 5.5 miles of existing bus routes to be graded and paved with plant-mixed surfacing and asphalt concrete. District X, Bus Routes Project No. 2. Louis Biasotti & Son, Stockton, $94,269; Piazza & Huntley, San Jose, $97,101; C. M. Syar, Vallejo, $99,542; E. A. Forde, San Anselmo, $101,152; Heafey-Moore Co., Oakland, $105,802. Contract awarded to Lee J. Immel, Berkeley, $92,740.

SOLANO COUNTY—In Vallejo Township, about 4.7 miles of existing bus routes to be graded and surfaced with plant-mixed surfacing. District X, Bus Routes Project No. 3. Louis Biasotti & Son, Stockton, $86,730; Lee J. Immel, Berkeley, $88,255; C. M. Syar, Vallejo, $91,016; E. A. Forde, San Anselmo, $91,460; A. G. Raisch, San Francisco, $95,376; Heafey-Moore Co., Oakland, $101,663. Contract awarded to Piazza & Huntley, San Jose, $80,686.

SISKIYOU COUNTY—Bridge to be constructed across Irving Creek about 9 miles north of Somes Bar. District I, Route 36, Section A. C. C. Gildersleeve, Willows, $9,558; E. E. Smith, Hilt, $10,115. Contract awarded to J. D. Proctor, Inc., Richmond, $6,849.

VENTURA COUNTY—Between Santa Clara River Bridge and Santa Clara Avenue, 1.6 miles to be repaired with plant-mixed material and bituminous surface treatment to be applied to shoulders. District VII, Route 9, Section A. Oswald Bros., Los Angeles, $20,870; Griffith Co., Los Angeles, $23,367. Contract awarded to G. W. Ellis, North Hollywood, $17,030.

VENTURA COUNTY—Construct Portland cement concrete lined drainage ditch on telephone road near Victoria Avenue about 0.3 mile in length. District VII, Route 9, Section A. Vinson & Pringle, Los Angeles, $10,875; Bebek & Brkich, Los Angeles, $15,500. Contract awarded to Ralph A. Bell, San Marino, $9,910.

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CALAVERAS COUNTY—Between Toyon and West Point, about 17.9 miles in net length to be graded and surfaced with road-mixed surfacing on imported base material. District X. Louis Biasotti & Son, Stockton, $259,979; Phoenix Construction Co., Bakersfield, $264,779; A. Teichert & Co., Sacramento, $383,102; Guerin Bros., So. San Francisco, $385,372. Contract awarded to Claude C. Wood, Lodi, $259,595.

CALAVERAS COUNTY—Between Altaville and Murphys about 6.7 miles to be graded and surfaced with road-mixed surfacing on untreated rock base. District X. Phoenix Construction Co., Bakersfield, $110,682; Harms Bros., Sacramento, $137,705; A. Teichert & Company, Sacramento, $137,870; Guerin Bros., South San Francisco, $140,780. Contract awarded to Louis Biasotti & Son, Stockton, $92,582.

HUMBOLDT AND DEL NORTE COUNTIES—At various locations between Orick Maintenance Yard and west boundary of Siskiyou National Forest, furnishing and stockpiling mineral aggregate and screenings. District I, Route 1, Sections K.C. Marshall S. Hanrahan, Redwood City, $11,504; Mercer Fraser Co., Eureka, $13,400. Contract awarded to Tom Hull, Eureka, $10,100.

MARIN COUNTY—A portion of an existing concrete box culvert to be removed and replaced with a new reinforced concrete box culvert on timber pile foundation, near Waldo Point. District IV, Route 1, Section C. John G. Leibert Co. & C. W. Caletti & Co., San Rafael, $8,430; A. G. Raisch, San Francisco, $9,190; G. M. Carr, Santa Rosa, $9,670. Contract awarded to Peter Sorensen, Redwood City, $5,190.

MONTEREY COUNTY—At the Salinas River near Neponset, a detour bridge and approaches to be removed, and related work to be performed. District V, Route 56, Section I. M. J. Murphy, Inc., Carmel, $10,000; Dan Caputo, San Jose, $11,592; Kiss Crane Co., El Cerrito, $13,408. Contract awarded to James B. Allen, San Carlos, $9,824.

ORANGE COUNTY—On Ocean Avenue, through the city of Huntington Beach, between west city limits and east city limits, about 3.3 miles to be repaired with plant-mixed material. District VII, Route 60. Griffith Co., Los Angeles, $40,975; Ansco Construction Co., Long Beach, $41,030; Pacific Rock & Gravel Co., Los Angeles, $51,750. Contract awarded to Sully-Miller Contracting Co., Long Beach, $34,990.

PLUMAS COUNTY—Across Indian Creek about 11 miles west of Quincy. District II, Route 21, Section B. Contract awarded to C. C. Gildersleeve, Willows, $14,361.

SAN FRANCISCO CITY AND COUNTY—San Francisco-Oakland Bay Bridge east span of west bay crossing, two suspension ropes to be installed and one damaged suspension rope to be removed. District IV. Contract awarded to Columbia Steel Company, San Francisco, $5,916.

SAN FRANCISCO COUNTY—In the city of San Francisco, Funston Avenue approach to the Golden Gate Bridge, about 0.2 mile of barbed wire fence to be constructed. District IV, Route 56. Anchor Post Fence Co. of California, $1,470. Contract awarded to Cyclone Fence Division American Steel & Wire Co., San Francisco, $1,327.

position where the bidder can not disclaim the authenticity of the proposal and in the case of an unsigned bid, the bidder might readily claim that it was delivered in error and that he had no intention of bidding.

One difficulty which frequently occurs is that of an incomplete signature. This may happen when the firm name appears on the space provided for the signature but there is no signature of an officer, in the case of a corporation; of one of the partners in the case of a copartnership; or the principal in the case of an individual. The reverse of this error likewise occurs. The signature of a partner, the principal or an official may be signed without the firm name appearing as part of the signature. These omissions always raise a question as to the validity of the proposal.

Another signature irregularity which crops up from time to time is that of a proposal signed by a person other than the principal and for whom a power of attorney has not been filed with the Division of Highways. While the fact of the granting of a power of attorney may be established after bids are opened, the lack of it at the time of opening always casts a shadow on the authenticity of the proposal.

In the submission of a proposal by two or more contractors as a joint venture it is most desirable that the bid be signed by all the firms or individuals interested in the bid. Compliance with this practice eliminates any question as to the identity of the bidders.

It is likewise desirable that the names of officials of corporations, members of copartnerships or interested parties be listed in the space provided therefore on the signature page.

As previously stated the form of signature on the bid should agree with the form appearing on the contractor's license and on his prequalification statement.

Another place where irregularities occur is in connection with the bidder's guaranty which accompanies the proposal.

As statutes require that all bids submitted for proposed State highway work be accompanied by a guaranty amounting to at least 10 per cent of the amount bid in the form of cash, cashier's check, certified check or bidder's bond, a proposal submitted without such guaranty can not, of course, be considered.

BIDS AND AWARDS

NOVEMBER, 1943 (Continued)

SANTA BARBARA COUNTY [illegible] District V, Route [illegible] [illegible] $[illegible]; [illegible] Los Angeles, $[illegible]; [illegible] $[illegible]; [illegible] Los Angeles, $[illegible]; [illegible] Contract awarded to [illegible] $[illegible].

SAN BERNARDINO COUNTY [illegible] District VIII [illegible] San Bernardino, $[illegible]; G. W. Ellis, North Hollywood, $[illegible]; [illegible] Co., Los Angeles, $116,258; [illegible] $121,[illegible]; [illegible] $[illegible]; [illegible] Bros., Los Angeles, $[illegible]. Contract awarded to [illegible] Co., Los Angeles, $[illegible].

SISKIYOU COUNTY. Near [illegible] about 2 miles [illegible] of Mt. Shasta [illegible] of Station 84 about 2 miles [illegible] of Yreka. District II, Route 3, Sections A [illegible]. Contract awarded to Clements & Co., Hayward, $4,24[illegible].

SISKIYOU COUNTY. Furnishing and stockpiling [illegible] aggregate and plant-mixed surfacing near Big Springs road about 4.5 miles [illegible] from Weed. District II, Route 72, Section A. Contract awarded to A. R. McEwen, Sacramento, $[illegible].

VENTURA COUNTY. Between 0.4 mile [illegible] of Nauman road and [illegible] Creek, about 4.1 miles to be repaired with plant-mixed material on untreated rock base, and plant-mixed material on the existing pavement. District VII, Route [illegible], Section A. Phoenix Construction Co., Bakersfield, $59,[illegible]; Griffith Co., Los Angeles, $[illegible]; Guerin Bros., So. San Francisco, $[illegible],370; Schroeder & Co., Roscoe, $75,30[illegible]. Contract awarded to G. W. Ellis, North Hollywood, $58,935.

One of the chief difficulties in regard to the guaranty is that the amount is less than the required 10 per cent. This occurs most frequently when the bidder makes an arithmetical error in the extension or addition of his bid and, upon being checked, it is found that the total of the bid is greater than originally figured by the contractor. Attorneys for the department have ruled that the law in this instance is most specific in the statement "at least 10 per cent of the amount bid." Ten per cent of the bid total is a definite amount and the guaranty can not be less than this definite amount.

Other difficulties in connection with the guaranty seem to occur mostly in cases where bidder's bonds are submitted as the guarantee that the bidder will enter into a contract if it is awarded to him. The most frequent irregularity in this regard is that the bidder's bond is not on the form prescribed for State highway contracts. The State form varies from the commercial forms printed by surety companies in several respects, chiefly in that the commercial forms make no guaranty that the bidder will furnish a labor and material bond if the contract is awarded to him. There should be no reason for a surety company not using the prescribed State form as it is included in the proposal form booklet or separate copies may be obtained from the office of the State Highway Engineer in Sacramento.

Bidders bonds are frequently submitted which are not signed by the bidder himself, or the signature of surety is incomplete or not properly acknowledged. There also have been several instances where the notary's acknowledgment of the surety's signature was incomplete.

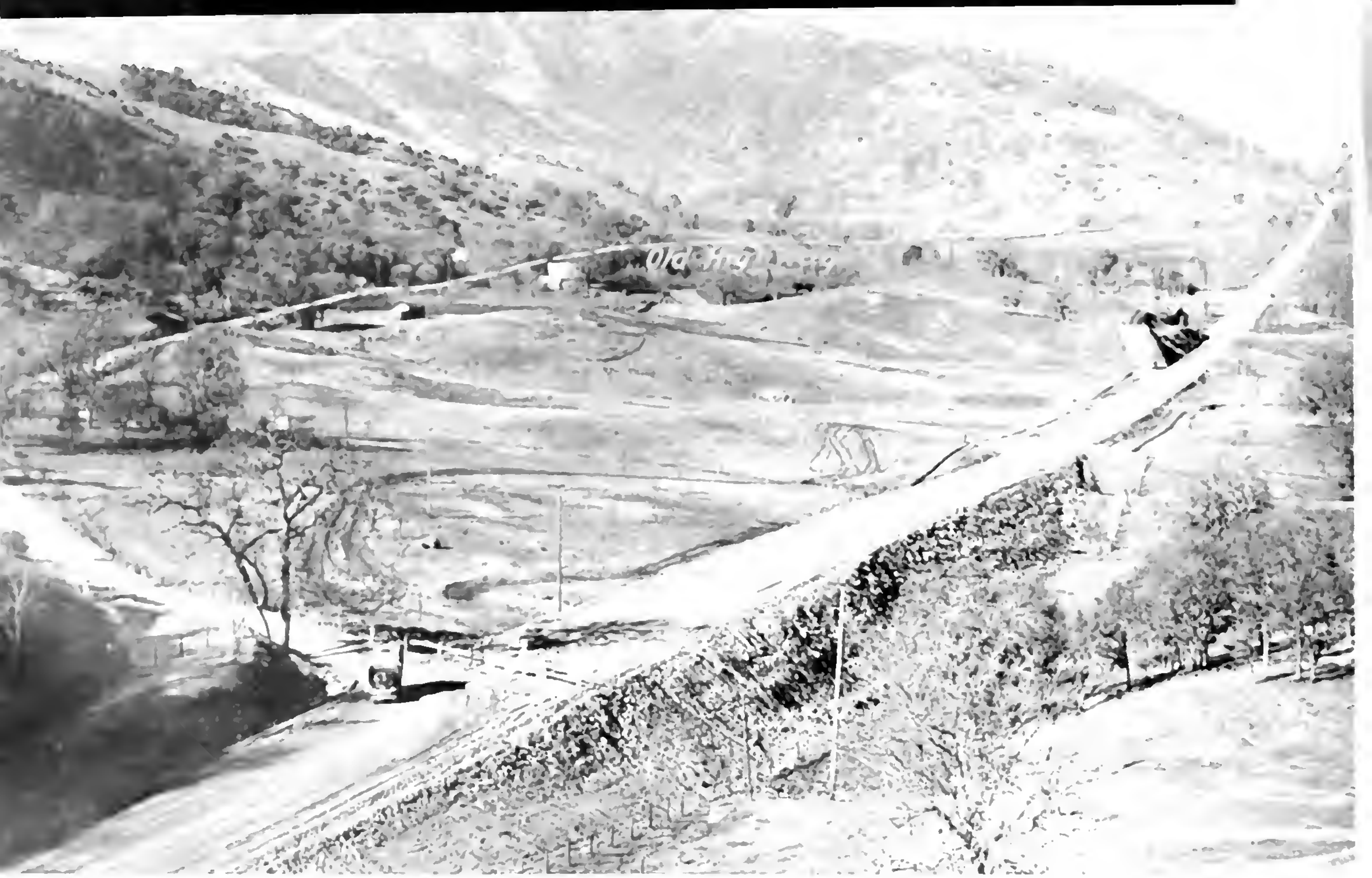
Once or twice in the history of bid opening for State highway work, a bidder, in submitting proposals on two or more projects on the same day, has mixed his 10 per cent guaranty checks between the proposals, with the result that the check for one of the projects was insufficient. Similarly, proposals have been placed in the wrong envelope, with the result that the envelope was not opened until all bids had been read for the project for which the proposal was intended.

DON'T MAIL SPECIAL DELIVERY

Another mistake is to send a proposal by special delivery to the Division of Highways in Sacramento. As the division has a private box in the post office which is opened at 2 o'clock p.m. on bid opening days and special delivery mail is not placed in the box but held for call, the method only delays delivery instead of expediting it. It has happened that this very delay has resulted in a proposal being delivered too late for the opening. Proposals received too late are always returned to the bidder unopened.

In the interpretation of statutes and rules and regulations governing bidding, the Division of Highways has no desire to be hard-boiled or hypertechnical. The desire is to secure the lowest responsible bid possible, but in fairness to the State and to other bidders compliance with all legal technicalities must of necessity be observed. Many of these technical requirements are not of the division's making. The laws governing the licensing of contractors were enacted at the instance of the contractors themselves and the use of bidder's bonds for guaranties was promulgated by surety companies and the highway department exercises no control other than to make sure that the statutes are followed.

One general rule which is followed in passing on the validity of proposals which have a taint of irregularity is: Can the State force the bidder to take the contract if he does not wish to. If he can not legally refuse, the bid is valid.



New direct routing of Redwood Highway section north of Hopland in Mendocino County. Dotted line indicates old route through hills

Curves and Flood Hazards Eliminated by Relocation on Redwood Highway

By A. M. NASH, District Engineer

THE completion of the grading and surfacing [illegible] between the town of Hopland and Crawford's Ranch in Mendocino County marks the reconstruction to modern standards at a cost of approximately $327,000 of the last remaining section of obsolete road on the Redwood Highway, U. S. 101, between Cloverdale in Sonoma County and Ukiah in Mendocino County, a distance via the new road of 29 miles.

Ten years ago, the section of road between these two points was an indirect [illegible] road with [illegible] and innumerable sharp [illegible] curves [illegible] modern traffic [illegible] by the [illegible] Division of Highways re[illegible] program [illegible] has finally been achieved with the completion of this last remaining 6.7 mile unit.

FLOOD HAZARDS REMOVED

After removal of the present wartime restrictions against pleasure driving and recreational travel, motorists from the San Francisco Bay region and the southern part of the State will unquestionably appreciate the final elimination of this section of substandard road, on their excursions to the Lake County resorts and the famous Redwood groves situated in Mendocino, Humboldt and Del Norte counties. In the meantime, this realigned, modern unit will effectively serve the expanding needs of the necessary transportational requirements of war time business and industry.

The superseded section of highway between Hopland and Crawford's Ranch was originally built in 1923. Not only were alignment and grade standards inferior for modern motor vehicle operation, but a far more serious defect was the flood hazard from high water in the adjacent Russian River.

At 11 different locations, the road was subject to overflow during flood peaks with all the consequent inconvenience to traffic, and upon occasions of extreme high water, complete stoppage of travel over this vital transportation artery.

All of these imperfections have been corrected on the new road, which has not only a more direct and pleasing alignment, but in addition, is located either on higher ground or with suffi-

Before and after views on recently improved section of Redwood Highway in the city of Hopland

ciently high embankments to clear the hazards of these flood waters.

The following comparison of the distance and curvature factors between the old and the new road conveys better than words the improvement which has been accomplished in the relocation of this unit of highway.

	Miles	Curves	Total curvature	Minimum radius feet
Old Road	6.98	34	924° 48'	200
New Road	6.70	10	187° 19'	1150

For a distance of 2,000 feet through the town of Hopland, concrete curbs and gutters were constructed and the street graded to a width of 60 feet between gutters. This width provides an eight foot parking strip on each side of the street without any resulting interference to the through highway traffic.

The graded section for the rest of the project is the standard 36 foot width except that for a distance of 2,650 feet a graded section varying from 36 to 54 feet was used to provide a maximum of 1,600 feet of four lane road over a vertical curve to correct an impaired sight distance for the designed speed.

Work started on this project during the fall of 1941 but because of the rainy season and difficulties of carrying on operations during the early war effort, in which work the contractor was actively engaged, the grading was delayed until the summer of 1942. During the winter season the contractor had completed the numerous reinforced concrete structures which included two reinforced concrete bridges at Crawford and McNab Creeks. Consequently, when grading was finally resumed in July, 1942, there were no delays resulting from lack of grading room.

BIG EXCAVATION JOB

That the contractor took advantage of this ideal working condition is indicated by his progress on grading during the August, September, and October of 1942 in which period he removed and compacted into embankments 101,247 cubic yards of roadway excavation. This work involved 4,068,000 station yards of overhaul or the approximate equivalent of hauling one cubic yard of excavation 113,000 miles or $4\frac{1}{2}$ times around the earth at the equator.

Before the large summit cut between Crawford Creek and McNab Creek had been completely excavated, the designed $1\frac{1}{2}$:1 slope on the right showed development of a major slide. Besides flattening this side of the cut to an approximate $2\frac{1}{2}$:1 slope to stabilize the wet side hill, a pervious blanket of river gravel with an underdrain was placed full width of the excavated area before backfilling the cut to an elevation 11 feet above the original planned grade at the middle of the cut.

This grade raise was made to avoid removing support from deeper sliding planes, and thereby incur greater slide yardage. Subsequent events have conclusively justified the wisdom of this decision.

4-LANE SECTION PROVIDED

Backfilling the cut to this new grade provided sufficient additional width of roadbed to secure a section of four lane roadbed with only a very slight amount of additional excavation, which will eliminate any necessity for striping this section as a "nonpassing zone" due to the greater restriction in sight distance resulting from the raise in grade.

(Continued on page 20)

Redwood Highway improvement north of Hopland involved several long deep cuts on new direct routing

Orinda Junction on Sign Route 24, Oakland-Walnut Creek arterial, has full traffic signal control and channelization

New 4-lane Divided Highway Link Opened in Contra Costa County

By G. L. BECKWITH, Resident Engineer

THE recently completed section of State Sign Route 24, 2.14 miles in length, between one-quarter mile west of Orinda and one and three-quarters miles west of Lafayette, Contra Costa County, has resulted in a modern, four-lane divided highway on the grades and alignment completed under previous contracts in 1937.

For the most part, the earlier contracts provided a three-lane highway, except at the beginning of the present contract and over Charles Hill, where four-lane pavement was placed. The surfacing originally placed consisted of plant mix.

Sign Route 24 serves as the only direct connection between the towns of Walnut Creek, Saranap, Lafayette, Moraga and Orinda and the Oakland-San Francisco area. Since the opening of the Broadway Low Level Tunnel in 1937, the suburban development of these communities has been very extensive, and further development has only been checked because of war-time restrictions on building. In addition, this highway serves as a main route connecting the important industrial and agricultural area to the east of Walnut Creek with the metropolitan Bay District.

During the winter of 1941 and 1942, a slide occurred on this section of Sign Route 24 that resulted in a restriction of roadway width to two traffic lanes and, in addition, caused an uplift of the paved roadbed, causing a serious bottleneck at that point.

Corrective measures within this area consisted of installing during 1942, under day labor, an extensive system of hydrauger pipes to drain the slide area and under the present contract to raise the grade over the entire area, to provide for a change in drainage structures.

These included the installation of 140 lineal feet of 60-inch reinforced concrete pipe, and the placing of a strut of approximately 6500 cubic yards of roadway excavation at the toe of the sliding area.

The project consisted of widening the existing roadbed to a minimum of 64 feet and placing two 23-foot lanes of Portland cement concrete separated by a 4-foot dividing strip of asphalt concrete. The two outer 11-foot lanes of Portland cement concrete pavement were placed on imported borrow with a minimum depth of one foot; the two inner 12-foot lanes used the existing surfacing as base.

The 2-inch asphalt concrete in the central 4-foot dividing strip was placed on crusher run base five inches thick.

Within the slide area, the pavement consisted of a minimum of 12 inches of imported borrow, four inches of crusher-run base and five inches of asphalt concrete.

Median bars, three inches high and spaced at 20-foot intervals, were installed within the 4-foot dividing strip throughout the project, except in the channelized area at the Orinda intersection.

TRAFFIC MOVEMENTS CHANNELIZED

The channelization at the Orinda Junction provides left turn accelerating and decelerating lanes for all highway traffic movements.

In order to dispatch traffic through this intersection with maximum safety, a three-phase, traffic-actuated signal system provides for three separated traffic movements. Magnetic detectors located in each of the traffic lanes approaching the intersection inform the electronic traffic signal dispatcher of approaching vehicles.

The right of way period is then separately allocated to the highway traffic, cross traffic or left turn traffic in accordance with the number of vehicles that have crossed the traffic detectors.

AUTOMATIC SIGNAL CONTROL

With the absence of cross traffic or left turn traffic, the green interval will remain on the highway, but approaching cross traffic or left turn traffic will in turn be separately allocated the green interval.

The installation has been designed with post-war conditions in view, and the intersection will handle 3,000 cars per hour with a maximum of safety and a minimum of delay.

The approximate major quantities involved are:

Roadway Excavation	64,000 cubic yards
Overhaul	1,000,000 station yards
Imported Borrow	54,000 tons
Crusher Run Base	4,600 tons
Portland Cement Concrete Pavement	9,325 cubic yards
Portland Cement Concrete Structures	360 cubic yards
Asphalt Concrete	7,000 tons

The improvement of this section was let as a contract to Chas. L. Harney,

At top, slide section of State Sign Route 24 rebuilt as 4-lane asphalt concrete highway with hydrauger pipe drainage and 3-inch median bars. Below, section over Charles Hill with two 23-foot lanes of Portland cement concrete and 4-foot asphalt concrete dividing strip

San Francisco, California, at an approximate cost of $464,000.

Resident Engineer G. L. Beckwith was in direct charge of the work under the general supervision of District Construction Engineer R. P. Duffy and District Engineer Jno. H. Skeggs.

Dedication ceremonies were sponsored by the Orinda Fall Festival Committee on October 31, at which time traffic signals were put into operation.

Waldo Overpass Eliminates Marin County Traffic Hazard

State from an abandoned railroad in Santa Barbara County.

The project was completed at a cost of $88,776.24 including State furnished materials but exclusive of right of way costs. These construction funds were furnished by the Federal Government from Access Road Funds.

The right of way was purchased by the State from State Funds at an approximate cost of $8,000. Harold W. Ruby was superintendent for the contractor in charge of the work. George A. Crayton of the Bridge Department supervised the construction of the undercrossing structure.

California Signs Mark Solomon Island Road

"WOULD it be possible," wrote Capt. B. W. Decker, United States Navy, from the South Pacific to Thomas H. Dennis, Maintenance Engineer of the State Division of Highways, "to send us some California road signs so that our boys from the Golden State who helped take the Solomons away from Tojo for keeps will feel more at home?"

Upon receipt of Capt. Decker's letter, Dennis transmitted the request

Jeep driver stops to ponder signs

to James Johnson of the California State Automobile Association, which organization furnishes the directional road signs which mark all California highways. Several signs promptly were sent to Capt. Decker.

Dennis recently received a letter of thanks from Capt. Decker and a photograph of a puzzled Marine standing beside his jeep at a crossroad in the Solomons. On a palm tree are three signs, one pointing in the direction of Camp Alligator and above it the familiar marker of State Sign Route 1, the highway that runs from Humboldt County to a connection with U. S. 101 in Santa Barbara County.

Below is a U. S. 40 sign, the like of which motorists follow from San Francisco Bay to the California-Nevada boundary east of Truckee.

"The signs sent to us have been installed and are the pride of all hands at Camp Alligator," Capt. Decker wrote Dennis. "We know our road is the best marked road in the Solomons, for the grand State of California did the marking, thanks to you.

"Tojo has acquired many new worries since December 7, 1941. The enclosed picture represents just one more spike in his coffin. As fast as we drive the Japs out, in comes a road and up goes a sign. We laugh while we fight—we laugh while we work. Yes, Tojo has a barrel of troubles."

Redwood Highway Relocation Eliminates Hazards

(Continued from page 17)

The major items of work on this contract, which required 203,036 man hours of labor of all classifications to complete, were as follows:

505,007	C.Y.	Roadway excavation
6,728	"	Structure excavation
4,915,645	S.Y.	Overhaul
60,327	C.Y.	Imported borrow
124,995	Lbs.	Reinforcing steel
3,883	"	Miscellaneous steel
14,166	L.F.	Culvert and underdrain pipe

The initial contract did not embrace the construction of a surfacing for the road, but was limited to the grading of the roadbed and the placing of a base course of creek-run gravel. Consequently, it was planned to immediately contract for the construction of an armor coat wearing surface over the entire project during this summer.

The completion of this latter item early in July put the new alignment in a satisfactory condition to serve the needs of traffic for many years to come, both in war and in peace.

The grading contract work was performed by the Maceo Construction Company of Clearwater, California, the work being under the general direction of Supervising Superintendent H. W. McKinley and Field Engineer O. A. Tucker.

The armor coat surfacing contractor was E. A. Forde of San Anselmo.

The inspection and supervision of the work for the State Division of Highways was by Resident Engineer C. M. Butts and an able staff of assistants.

Francis J. Carr Becomes U. S. Navy Lieutenant

Francis J. Carr, member of the legal staff of the Division of Contracts and Rights of Way, recently commissioned Lieutenant (j.g.), United States Navy, was granted military leave and on October 27th left to take up his new duties.

Lt. Carr is now stationed at Quonset Point, Rhode Island, where he is enrolled in the Navy Training School. A native of Redding, Lt. Carr entered State service on April 9, 1940, later being promoted to the post of attorney under C. C. Carleton, Chief, Department of Contracts and Rights of Way. He was a graduate of Santa Clara University and of the University of California School of Law.

L. A. Bridge Steel Erection Job

(Continued from page 5)

40-ton crawler cranes and swung into position while one crane held the load steady and the other moved it slowly backward.

The placing of the floorbeams, stringers, and stiffening trusses between the girders was done by a truck crane operated from a runway constructed on top of the girders.

The fabrication of the structural steel was excellent and no difficulties were encountered during the erection.

Postwar Road Program

(Continued from page 9)

postwar period with a State Highway System far below the standards necessary for proper service to traffic.

The greatest handicap confronting the Division of Highways in preparation of its postwar program is sufficient engineering manpower. The division has lost 750 employees to the armed forces, many from key positions, and others have left to take more remunerative positions in war industries. The department, however, is using all personnel, not needed for maintenance operations or Federal Access and Flight Strip construction, on surveys, preparation of plans, specifications and estimates and on work in connection with right of way acquisition.

Details of the State highway postwar construction program approved by the California Highway Commission are given in the tabulations accompanying this article on pages 10-12.

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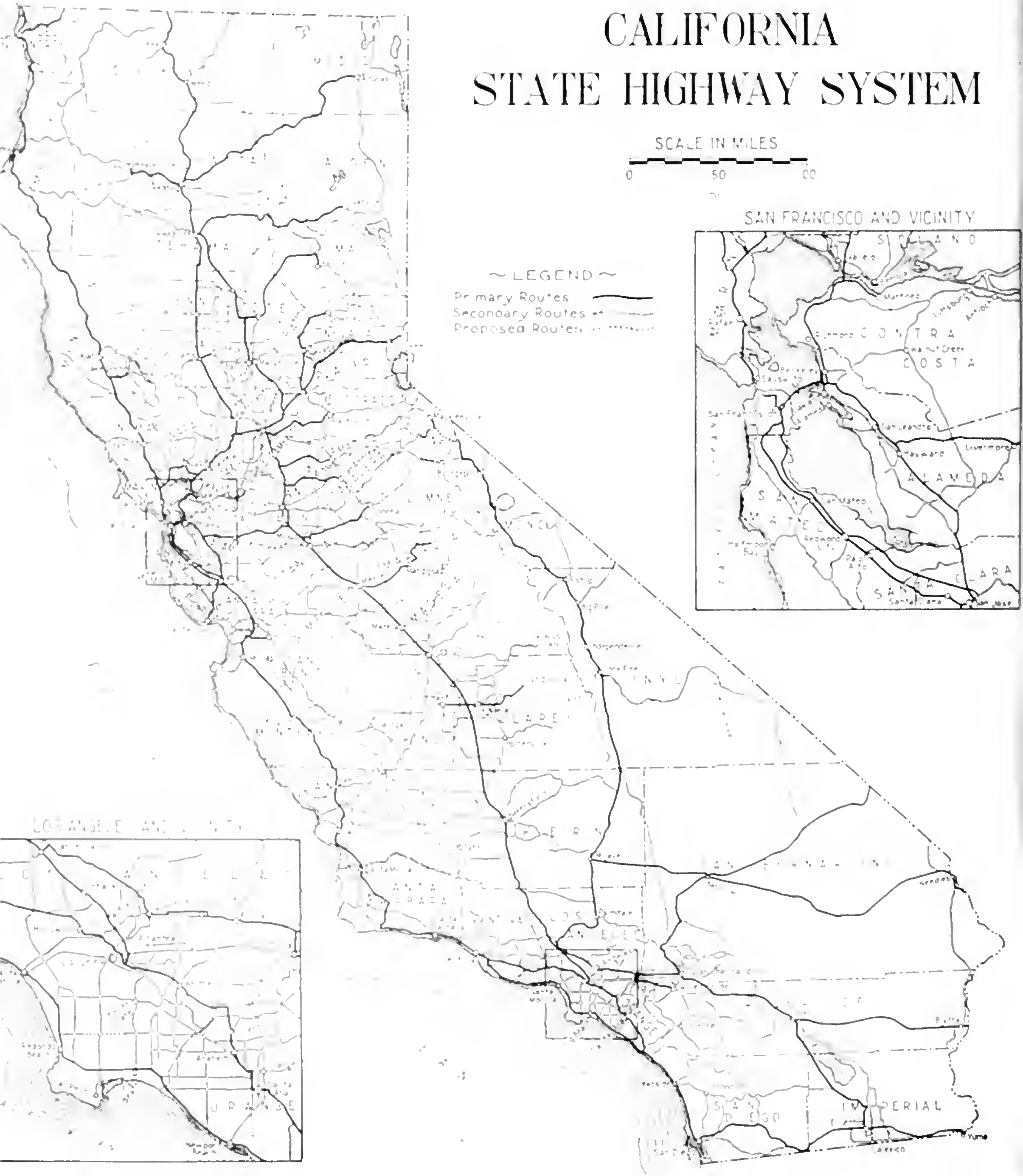
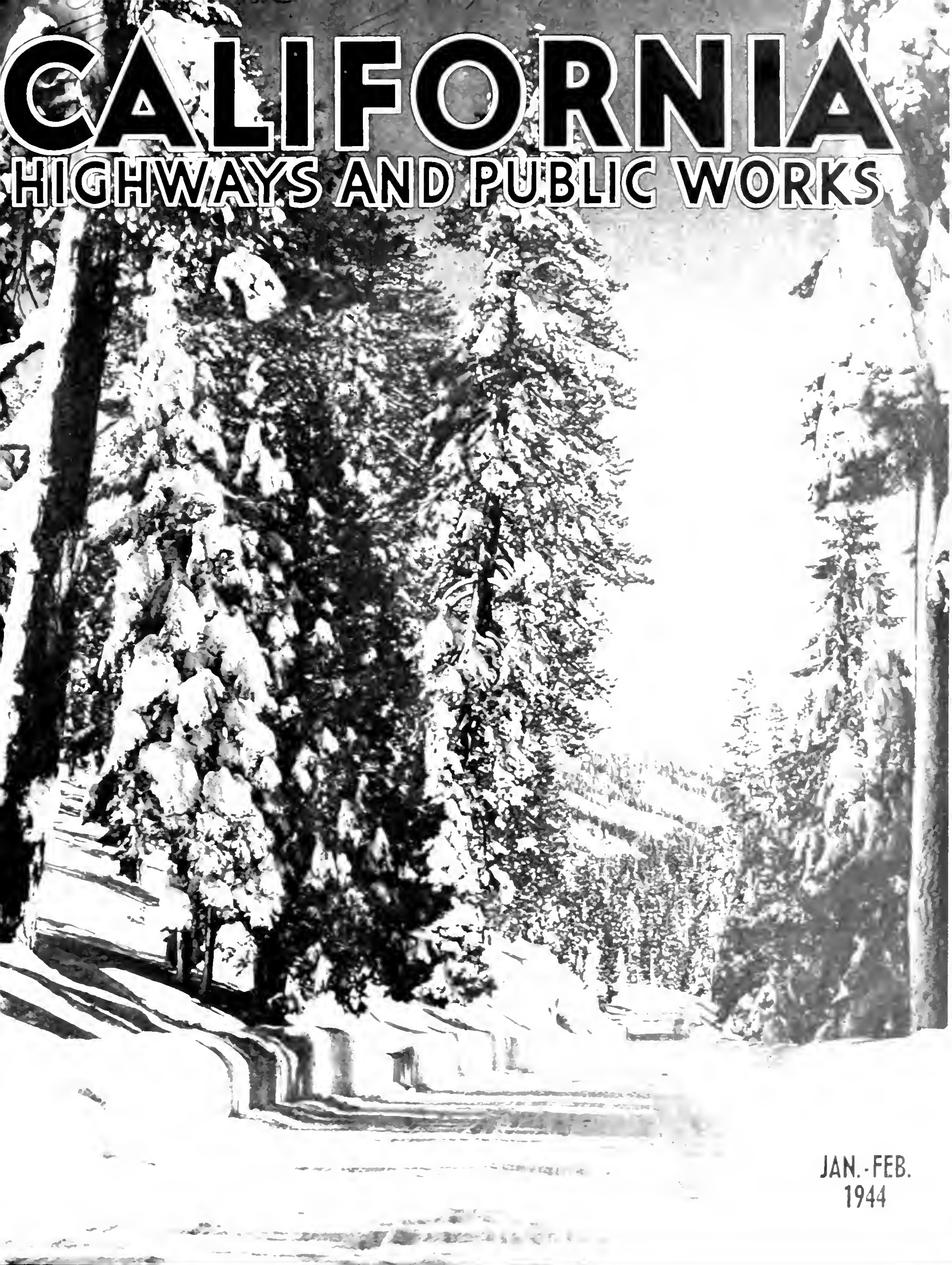


CALIFORNIA HIGHWAYS AND PUBLIC WORKS



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State Highway Commission Approves 61 Projects for Road Repairs This Summer Totaling 357.8 Miles

THE highway program proposed for postwar construction by Director of Public Works C. H. Purcell, State Highway Engineer George T. McCoy, and the California Highway Commission was modified to some degree by the commission at its meeting in Sacramento on January 20th when a few projects were added to the previously adopted list shown in the November-December issue of this magazine. The commission also approved a program for imperative repairs to highways this summer estimated to cost $3,216,000.

With the added projects the postwar program now includes 124 projects covering approximately 588 miles of proposed road improvements as well as more than 100 bridges and grade separations.

The additional postwar projects voted by the commission as the result of more detailed and accurate estimates that had become available are as follows:

FOR POSTWAR CONSTRUCTION

Colusa County, Route 7, from Arbuckle to 4 miles south of Williams, grade and surface and five bridges, 6.4 miles.

Sonoma County, Route 1, from south county boundary to one mile south of Petaluma, grade and pave, 3 miles.

Sonoma County, Route 1, from 0.3 mile south to 1.7 miles north of Santa Rosa, relocation through city of Santa Rosa, grade and pave, 3.7 miles.

Santa Cruz County, Route 56, from Aptos to Santa Cruz, grade and surface (4-lane divided), 6 miles.

Inyo County, Route 23, between Independence and Division Creek, grade and surface, 10 miles.

Amador County, Routes 65 and 34, from north of Jackson to east and south of Jackson, grade and surface, 2.1 miles.

Lake County, Route 89, from 1.2 miles north of Rodman Narrows Road to Route 15, Scott and Robinson Creeks bridges, grade and surface, bridges, 2.4 miles.

San Benito County, Route 119, from 0.5 mile north of Cottage Corners to Santa Clara County line, grade and surface, 8.2 miles.

The two projects included in the list published in the November-December issue for surfacing of portions of the Ducor cutoff (Route 129) between Bakersfield and Porterville in Kern and Tulare counties have been replaced by a single project to complete the Ducor cutoff by grading and surfacing the 24 miles between the junction of Routes 4 and 129 and Ducor.

SUMMER REPAIR WORK

The repair program necessary for the reconditioning of highways this summer is urgent, because under the cessation of construction and reconstruction, the State highway system is deteriorating through obsolescence, limited maintenance and the increased rate of damage resulting from large volumes of wartime heavy trucking. It comprises 61 projects totaling some 357.8 miles.

PRIMARY NORTH

Mendocino and Humboldt counties, Route 1, portions between Rattlesnake Summit and Garberville; repair base, place plant-mixed bituminous material and seal coat, 9.8 miles.

Tehama County, Route 29, from junction with Route 83 to easterly boundary; repair base, place plant-mixed bituminous material, 12.9 miles.

Tehama County, Route 29, portions between Paynes Creek and Mineral; repair base, place plant-mixed bituminous material, 16.8 miles.

Modoc County, Route 28, portions between 3 miles east of Rush Creek and Chambers Ranch; repair base, place plant-mixed bituminous material, 14.2 miles.

Lassen and Modoc counties, Route 28, from 3 miles west of Adin to 3 miles east of Rush Creek; repair base, place plant-mixed bituminous material, 11.7 miles.

Plumas County, Route 29, portions between Tehama County line and Lassen County line; repair base and place plant-mixed bituminous material, 8.0 miles.

Sutter and Butte counties, Route 3, portions between Yuba City and Nelson; repair base and place plant-mixed bituminous material, 5.3 miles.

Butte County, Route 3, portions between Nelson and Chico, repair base and place plant-mixed bituminous material, 2.8 miles.

Sacramento County, Route 4, portions between McConnell and Sacramento; repair base and place plant-mixed bituminous material, 8.3 miles.

Yolo and Colusa counties, Route 7, portions between Bretona and Genevra; repair base and place plant-mixed bituminous material, 3.0 miles.

Placer County, Route 37, portions between Auburn and Colfax; repair base and place plant-mixed bituminous material, 2.0 miles.

Marin County, Route 1, from Manzanita to Golden Gate Bridge; place plant-mixed bituminous material, 3.2 miles.

Alameda County, Route 5, portions between Hayward and Livermore; repair base, place plant-mixed bituminous material and seal coat, 2.3 miles.

Marin County, Route 1, portions between San Rafael and Sonoma County line; repair base, place plant-mixed bituminous material and seal coat, 2.0 miles.

Alameda County, Route 5, from San Joaquin County line to connection with four-lane pavement; repair base and shoulders, place plant-mixed bituminous material, 2.0 miles.

Alameda County, Route 5, from Del Sur Avenue to south city limits of San Leandro; repair base and place plant-mixed bituminous material, 0.3 mile.

Marin County, Route 1, portions between Alto and San Rafael; place

(Continued on page 12)

Arroyo Seco Parkway Extension Adds Four Southbound Traffic Lanes

By A. N. GEORGE, District Construction Engineer

WHEN the Arroyo Seco Parkway was opened between Avenue 22 in Los Angeles and Glenarm Street in Pasadena on December 30, 1940, work had already been started on a road which was to become the southbound traffic lanes of an extension of this Parkway southerly from Avenue 22 to Adobe Street in Los Angeles.

At the time the Parkway was opened it fed southerly into a four-lane undivided highway which crosses over San Fernando Road, the Los Angeles River and the Southern Pacific Railroad on a viaduct which provided for two lanes of traffic in each direction and through four tunnels under Elysian Park to Adobe Street.

Riverside Drive connected with the road just southerly of the viaduct, making a left turn necessary across southbound traffic at grade. Solano Street made a grade intersection with this road, as did Bishops Road, Cottage Home, Castelar and Bernard Streets.

The year 1941 proved to be a poor year for road construction as by the middle of summer a steel shortage had developed which prevented the steel companies from furnishing the girders for the new viaduct bridge over the Los Angeles River and Riverside Drive. Therefore, the completion of the southbound lanes, which would make it possible to eliminate all of the above mentioned grade intersections, became dependent upon the delivery of these steel girders.

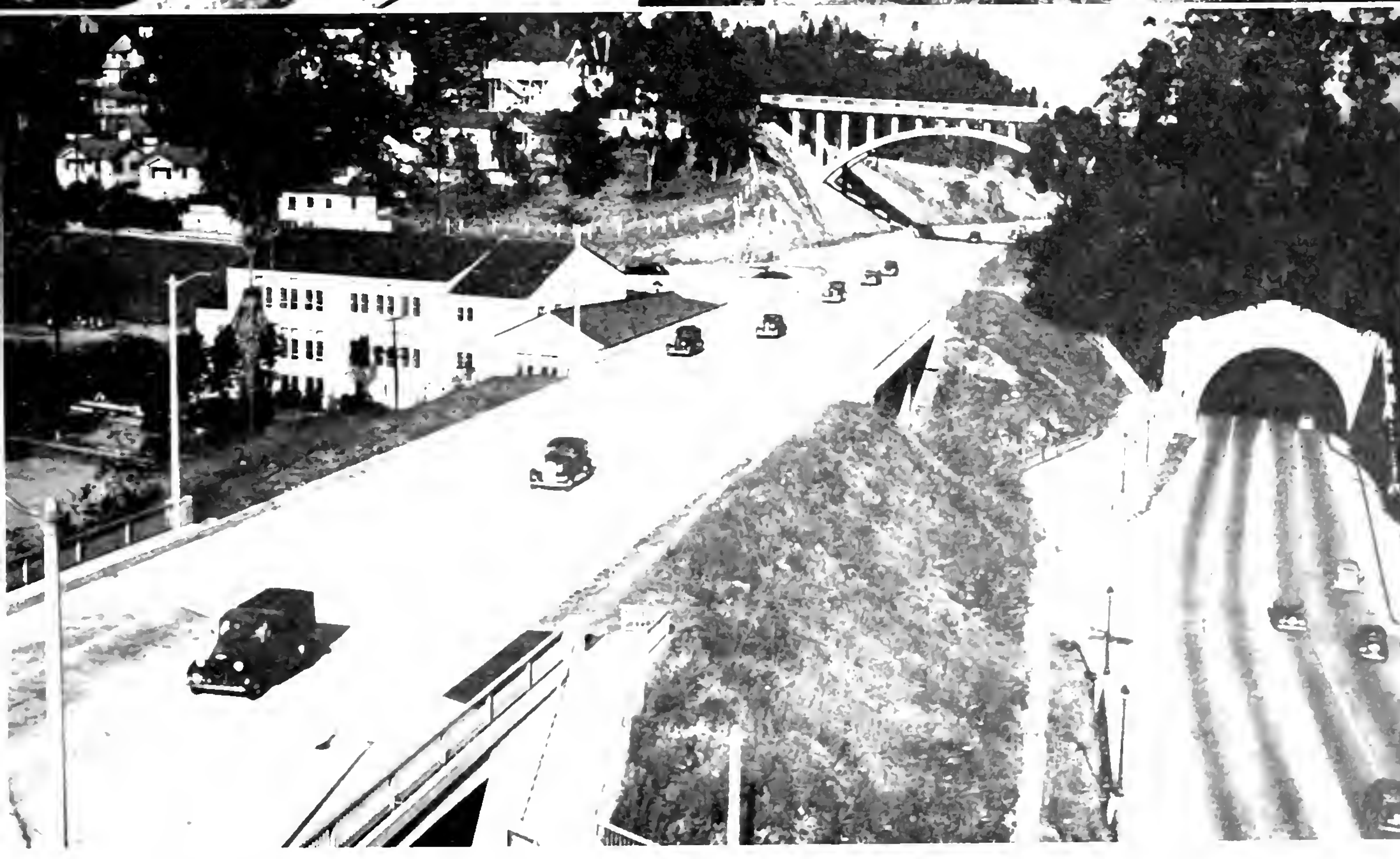
Work on the roadway throughout and on the concrete portions of the new Los Angeles River bridge was carried on during the following years under a WPA project. On December 30, 1942, the WPA project was closed down by the Federal Government, but the major portion of all work necessary to make the highway usable, with the exception of the steel spans of the bridge, had been completed.

Under the WPA project the piers for the steel structure were constructed and the concrete approach spans, together with all other road work, including curbs and pavement, were completed to Adobe Street. Grade separations at Castelar, Bishops Road, Amador Street, Solano Street, and Park Row were constructed under Bridge Department contracts.

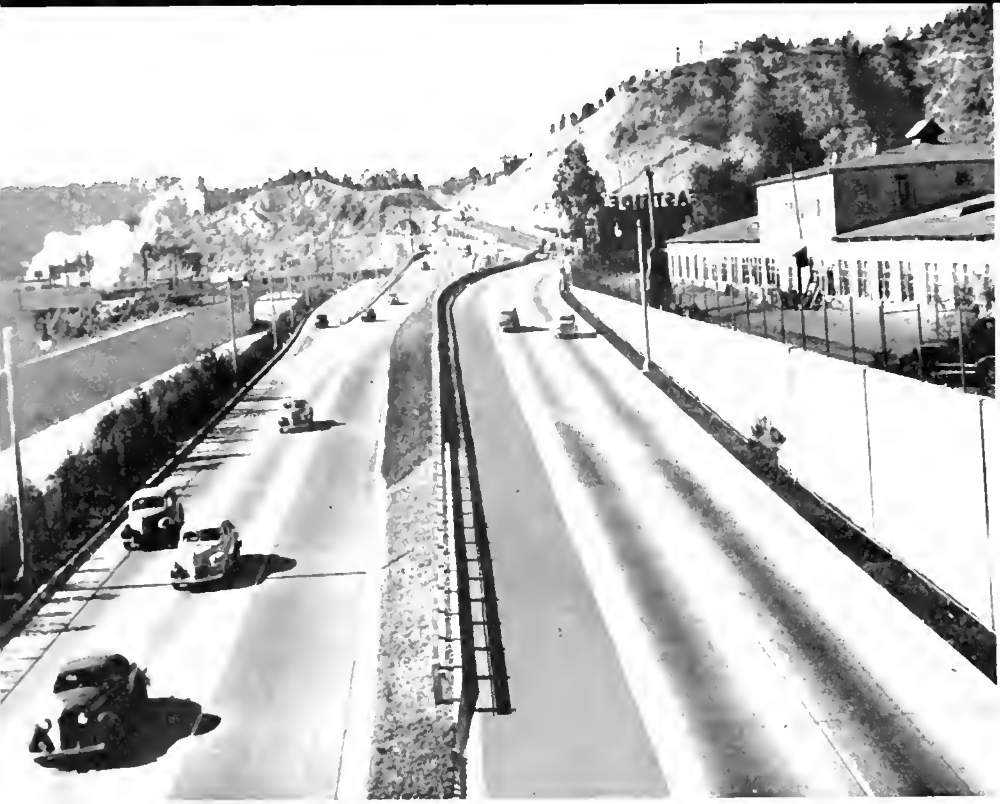
In June, 1943, the Bethlehem Steel Company, who had the contract for the steel superstructure of the Los Angeles River bridge, were able to make delivery and erect the girders. A contract was then awarded to A. S. Vinnell Company and Engineers Limited for the construction of the concrete deck and railing of the river bridge and certain work on the approaches.

This work was completed to a degree that made it possible to open the south-

The newly completed Arroyo Seco Parkway Extension viaduct and bridge for southbound traffic only are shown at left of picture
Old viaduct and bridge over Los Angeles River for northbound traffic are seen at right



At top southbound traffic is approaching Los Angeles on new Arroyo Seco Extension and through [illegible] in E[illegible] Park. C[illegible] H[illegible] background. Old road at left. Below—Southbound traffic passing under Park Row Bridge and North[illegible]



On the above section of Arroyo Seco Parkway opposing traffic proceeds on different levels separated by railing and planted slope

bound highway on December 31, 1943, thus giving the heavy New Year's day traffic the benefit of the Parkway from Adobe Street in Los Angeles to Glenarm Street in Pasadena. Certain items of work under the A. S. Vinnell Company and Engineers Limited contract are not yet completed, but except for the periods when it will be necessary to divert traffic from the southbound roadway while certain of this work is being done, the public is having the use of the Parkway.

Another small contract has just been awarded to Vido Kovacevich for work in completing an accelerating lane near Bernard Street and some channelizing for inlets at Castelar and Solano streets. Even after this contract is completed, there will remain the landscaping of the highway through Elysian Park and surfacing of certain city streets which were disrupted by the Highway construction.

However, this work is deferred for the duration as not being of sufficient urgency to justify its being completed during the war.

The opening of this section of the Parkway marks another step in the completion of a freeway from the heart of Los Angeles to Pasadena. The construction of such a road has been under discussion at various times since as far back as the 1890's and has been mentioned in each major traffic survey that was made of the Los Angeles District.

As early as 1922 the Los Angeles City Traffic Commission published a plan of major highways in Los Angeles which called for a roadway up the Arroyo Seco to Pasadena to be built as a double roadway, half on each side of the channel.

Although inviting the construction of a roadway by its freedom of expensive improvements along its banks the Seco presented a very real water hazard to any such highway project. In 1922, however, the cities of Los Angeles, and South Pasadena acquired a large part of the land which would be traversed by a Freeway in the Arroyo for park purposes.

At that time the State Highway Department was limited to the construction of highways outside of cities under bond issue funds. Later, with the advent of the gasoline tax and legislation liberalizing the highway policy, the State became actively interested in the construction of this freeway.

Still, the menace of flood water and the necessary heavy expenditure to protect against this menace was regarded a serious obstacle to construction of a highway along this location.

When the depression struck and it became necessary to find productive employment for a large number of men in the metropolitan area, the lining of the channel with concrete as a protection against flood waters in the Arroyo presented itself as a desirable project.

CHANNEL LINED BY WPA

Work on this lining was started by various relief agencies and was taken over by the WPA when that agency was formed and the lining of the channel from the south boundary of Pasadena to the Los Angeles River was completed by that agency with a Federal expenditure of $7,000,000, and an expenditure of $880,000 by four sponsors: the State Division of Highways and the cities of Pasadena, South Pasadena, and Los Angeles.

This expense, however, can not properly be chargeable entirely against the Parkway as the channel lining has also provided protection to park lands and private residence property.

With the flood waters adequately provided for, the construction of the highway presented no serious difficulties, and from its very inception has been marked by very complete cooperation by all of the agencies involved, which included the cities of Pasadena, South Pasadena, and Los Angeles, and the Federal agencies of the WPA, PWA, and PRA, with special mention being given to the Los Angeles Park Department which donated the necessary park land.

This cooperation has not been passive, but has been most active, each agency taking an active part in various portions of the highway planning and construction.

TOTAL COST $10,639,427

Without taking into consideration the original cost to the various cities of the park lands which were afterwards donated for highway purposes, the total cost of this improvement, including the purchase of rights of way outside the park lands, the moving of two railroads, sewers, the construction of four highway tunnels, etc., and one-half the cost of channel lining, is $10,639,427.

The length of the Parkway from Adobe Street in Los Angeles to Glenarm Street in Pasadena is practically nine miles. When it is remembered that a portion of the WPA expenditure must be considered as relief expenditure, the net cost of this Parkway would be less than one million dollars per mile.

Although the first true freeway to be constructed in California, this road is serving as a model for the design of other freeways.

Relation Between Right of Way and Freeway Design in Metropolitan Areas

The following article is a paper delivered December 2, 1943, by Fred J. Grumm, Assistant State Highway Engineer, California Division of Highways, before the Road Design Committee of the American Association of State Highway Officials.

By FRED J. GRUMM, Assistant State Highway Engineer

FORTIFIED with the information available in the recommendations promulgated by the American Association of State Highway Officials, basic concepts for the general design of a freeway in a metropolitan area apparently should be readily formulated. With the benefit of these instructions, survey, plan and design problems should be happily solved.

The problem, however, is more than one of designing for multiple lanes of traffic, median strips of ample width, outer highways of acceptable standard, interchange and separation structures, marginal treatment for protection and esthetic satisfaction.

As the preliminary studies proceed, more and more does the designer feel the influence of rights of way. As he goes forward with the detail design, he finds instance after instance of the close relation between the two functions.

Unless conditions are more ideal and uniform than are invariably met in California, the problem of securing access rights and rights of way suitable for adequate design will prove to be a major concern.

Many new problems arise when land is sought for establishing freeways in metropolitan areas. The generally high values in the urban territory and the variety of improvements, actual and potential, to which the lands are adaptable compel a careful study of choice in location, design and the respective limitations in right of way. The best results are obtained through broad-minded dealings in rights of way when coupled with ingenious adjustment in location and design.

It is a fact that land owners and shrewd legal council are alive to the opportunity for capitalizing on rights of way necessities. There must be a close understanding and cooperation between the engineering and the right of way departments. There must be well organized team work throughout plan preparation.

The following briefly calls your attention to some of the right of way relations incidental to developing plans for economical and consistent costs without violating the principles of highway design to which we now subscribe.

GENERAL FACTORS OF DESIGN

Right of way width is one of our first concerns in setting up the requirements of a freeway proposal. In these urban areas, including highly developed industrial, commercial and residential establishments, arbitrary selection of right of way width is not the acceptable method. It is governed by design requirements and the widths of typical section which in turn are composed chiefly of the following:

1. Number and width of freeway lanes;
2. Outer highways;
3. Median strips;
4. Accelerating and decelerating lanes;
5. Intersection treatment;
6. Border treatment and slope requirement.

Our interest centers in how flexible these dimensions are if confronted with serious restrictions in right of way; to what extent can they be manipulated without detriment to traffic needs; how much can right of way provisions give and take on an economic basis to further the desirable and approved standards for the freeway.

1. Number and Widths of Lanes

The freeway lane widths and number of lanes obviously are not subject to much adjustments to meet right of way conditions, assuming that the preliminary determinations of the freeway requirements are correctly concluded. It will be 12-foot width for all of the 4, 6, or 8 freeway lanes on California State Highways.

What about shoulder widths? The shoulder is preferred to curbed edges because it provides emergency parking ground; facilitates surface run off. It *does* involve width additional to pavement dimensions. In tight right of way situations, the use of curbed edges can save 15 to 20 feet of width the shoulders ordinarily occupy.

That much right of way reduction can often avoid destruction or removal of expensive buildings or improvements. The minimum may also keep roadway slopes within bounds of reasonable property acquisition. It may be the means of salvaging a side street for use as an outer highway.

2. Outer Highways

On freeways there is the option of obtaining access rights from adjacent property or of furnishing outer highway facilities. Preservation of this distinctive characteristic of the freeway against the inevitable prejudice of the adjacent property owner brings out the genuine capabilities of the right of way departments. The designer can do much to facilitate procedure. The result is reflected in relative cost. Gain or loss of public good will can easily become an important issue.

Where outer highways must be provided we have adopted a minimum of two 12-foot lanes plus 8 feet for a single parking lane, a total width of 32 feet. That width may be saved if access rights are purchased. It is advantageous not to commit the department to construction and perpetual maintenance costs of outer highways where it can be avoided.

There are several methods whereby advantage can be taken of local conditions to minimize the problem of preserving limited access rights.

PURCHASE OF FRONTAGE

a. Locating parallel to a railroad so no access will be expected on that side. It is advisable to obtain an agreement to that effect. There are cases where it was more economical to relocate along such an obstruction or along a natural barrier than to widen along an existing highway and provide outer highways.

(b) Purchase of a whole tier or strip of lots along an existing highway. Thereby all frontage on one side is removed from demands of severance or access and no outer highway is required on that side. The center line of freeway is adjusted accordingly.

(c) Use existing parallel streets or roads as outer highways when they are available for ingress to property disturbed by freeway acquisition. This recourse naturally requires proper loop extensions and reasonable freeway connections. It relieves the freeway agency of the maintenance of the outer facility.

(d) Locate the freeway in the middle of a block whereby original access or frontage on existing streets is undisturbed. Minimum widths will then suffice for the freeway. This procedure is advantageous where original frontage is highly developed and additional width there would cause excessive property damage. The midblock or even backstreet location lends to closure of many of the lateral streets that otherwise would cross the freeway, because existing parallel streets remain to form belt routing to selected cross-overs.

(e) In relatively undeveloped sections in large ownerships, limited access directly to the freeway can often be arranged. Points of access are designated but cross-over of the freeway median strip are reserved, subject to highway authority determination. These arrangements obviate outer highway construction unless the property owner desires to so develop his own property. Many subdivisions have been handled by such negotiation.

When access rights are purchased and no outer highway or parallel street provides connections to streets dead ended at the freeway, the resultant cul-de-sac has occasioned considerable deliberation on how much contingent damage can run to property in the block containing the cul-de-sac. Accordingly it is safer practice to provide a loop street if that is cheaper than the estimated damage that might run to property affected. Of course, it is often probable that property owners may not bring up claims when not particularly inconvenienced by the street closure.

The cul-de-sac can be eliminated by connecting two or more dead end streets, as by outer highways, but not necessarily running continuously to reach every lateral. The bulb return in a dead end street is not sufficient to alter the status.

Construction economies are sometimes achieved and abutting property accommodated by constructing the outer highway at average ground level and not necessarily at elevation of the freeway. Contingent damages are eliminated and more ready property access is provided.

Experience has taught us not to attempt to save right of way width by restricting outer highways to one-way width along property that is enjoying frontage rights. In the higher courts are still pending appeals on adverse decisions that jeopardize some of the essential measures for maintaining freeway construction. At best, one way control is a police duty and even turning such streets over to a local agency under agreement to maintain one way control will not absolve of the initial responsibility.

Another consideration on outer highway width is the extent of the jurisdictional authority in restricting parking thereon to one side to eliminate the legal objections built up in the right of way acquisition. It is probable legislative action will be needed to give the department that authority. If parking is done on both sides of an outer highway designed for only one parking strip and two lanes of pavement, there will be difficulty in turning into and out of driveway entrances.

3. Median Strips

The width of median or dividing strips in freeways has a direct bearing on right of way width. When outer highways are included, three strips are required: the central freeway dividing strip and the two separations between freeway lanes and outer highway lanes.

These strips can be the minimum satisfactory for good design, and there is good reason to use for that purpose the A. A. S. H. O. standards. Often the utmost reduction in overall width of right of way is necessary to prevent unusual cost. The few feet width that can not well be gained by other means may be needed at critical controls as for walls to retain cut banks or fill slopes beyond which are set costly buildings or structures. The right of way appraisal dictates design in these cases.

For the central dividing strip, California is adopting a 12-foot width for ultimate minimum wherever separation structures may need center pier supports in the median strip. That width is predicated on a clearance of 4 feet from the edge of each pavement to face of pier and 4 feet width of pier, if necessary. These dimensions are the desired minimum and should be reduced only in extreme circumstances.

If separation structures having center piers are widely spaced, there may be an advantage in making transition in the dividing strip widths, provided horizontal curvature occurs to facilitate a smooth transition without introducing reverses.

Temptation to reduce the separators between the freeway and outer highways is felt when right of way tells design that width is getting critical. These separators are essential to protect traffic against conflict and to eliminate headlight glare of opposing vehicles. Generous widths are useful to facilitate inlets and outlets to the freeway; to adjust adjacent road levels where grade levels are different or superelevation appreciable.

Speed change lanes may be introduced without requiring alignment changes if sufficient width is introduced in these dividing strips. These outer median strips are safety valves in possible future unexpected expansion requirements. They may incidentally be provided by the slopes between roadways.

4. Accelerating and Decelerating Lanes

The accelerating and decelerating lanes widen the cross-section at intersection points and can not be ignored as a factor in establishing proper right of way widths. Coming at intersection points, often at grade separations and at inlets and outlets, the additional width is often at sites where land values are high. It is a requirement too often overlooked and too unwillingly taken into account. It has caused more squeeze plays in adjusting typical sections to acquired right of way than many another item in freeway designs.

5. Intersection Provisions

The intersection design can only be touched on in this paper. Intersections usually are already encumbered by improvements usually with high cost values, complicating determinations. If the intersection points can be picked as controls, where they can

(Continued on page 18)

Arroyo Seco Parkway

In this picture of the Arroyo Seco Parkway between Los Angeles and Pasadena may be seen many of the design and construction features essential to a true freeway as described by Assistant State Highway Engineer Fred J. Grumm in the accompanying article on the relation of right of way and freeway design in the metropolitan areas. In its entire length of 9.5 miles the Parkway has no street crossing intersection at grade nor any right or left turn across traffic. Instead there are 13 vehicular bridge separation structures for street traffic, three pedestrian separation structures and five steam or electric railroad separation structures. Closely paralleling the Arroyo Seco Channel, its route lies through [illegible] property through [illegible] the distance that natural barriers largely eliminates all problems of right of way acquisition and abutting property damages. The picture was made available through the courtesy of [illegible] magazine.

Building 29 Miles of Mountain Highway Increased War-needed Lumber Output

By C. E. BOVEY, District Maintenance Engineer, District X

AT a public gathering at Sutter Creek on the night of January 31 the Army-Navy "E" was awarded to the Winton Lumber Company and McDonald Lumber Company for increased production during the year 1943. This award is the result of a most outstanding example of cooperation between private industry, landowners, county supervisors and the State and Federal Governments in the building of 29 miles of new mountain highway that has resulted in increasing the output of over 8,000,000 feet of lumber a year.

Heretofore, owing to the bad condition of the narrow and curving old roadway, the logging production was practically abandoned during the winter months. Tom Mills of the Winton Lumber Company said that by reason of the improved highway the mills would get logs all winter and that the cut of 28,000,000 feet in 1942 would be increased from 35 to 36 million feet this winter.

At the beginning of this war lumber was thought to be very plentiful and in no sense a critical material. However, the huge building program soon created a critical shortage of lumber and timber products.

This material was particularly needed on the west coast and attention was focused upon the fine timber belt of the Sierra Nevada Mountains. Amador County, [illegible] the world's deepest gold [illegible] vast quantities of [illegible] cedar, ponderosa and sugar pine.

A number of mills have operated here for many years producing small quantities of lumber. Since 1941 a modern mill constructed at Martell has materially increased the lumber supply from this source.

The aggregate production [illegible] 1941 was approximately [illegible] board feet. These mills [illegible] operated less than 180 days per [illegible] and suspended operations [illegible] the winter season.

After Pearl Harbor War Production Board representatives demanded [illegible] on the part of all lumber companies to increase their production by working longer hours, a longer work week and year round production conditions they could not meet on the existing roads.

During the year 1942, the heavy laden lumber trucks, many carrying a gross load of 15 tons, caused serious failures in the highway surfacing between Martell and Cook's Station on State Highway No. 88, the Carson Pass lateral. Failures were particularly serious during the early spring and late fall months. The narrow, twisting mountain road, constructed for light traffic only, was entirely inadequate for such heavy hauling. It was apparent that increased production on an all-year schedule was impossible unless the road was reconstructed to an adequate standard.

Acting upon the request of logging and lumber companies and appropriate county, State and Government agencies, the War Production Board approved a project and appropriated funds for the reconstruction, widening, straightening, and surfacing of 29 miles of county and State highway from railhead at Martell, elevation 1,500 feet, to Cook's Station, 5,000 feet, junction of private logging roads and the State highway.

LUMBER COMPANIES COOPERATED

The sum of $300,000 was allocated from Federal Raw Materials Access Road funds to cover cost of surveys, engineering and construction. An additional $40,000 was provided from State Division of Highway funds. The McDonald Logging Company, principal commercial user of this highway, agreed to finance the cost of clearing and grading a number of major line and grade changes not included in the originally approved project but necessary to increase speed and ease of hauling.

The Winton and Berry Lumber Companies also contributed the sum of $1,000 toward grading costs on two of the major changes. Total contributions from the three companies amounted to approximately $16,000, making a total of $356,000 available for the entire project. This, an average of $12,300 per mile, is admittedly a low cost for heavy duty mountain construction under war time conditions.

DAY LABOR EMPLOYED

Preliminary estimates were based on rough surveys made with speedometer, car compass and aneroid readings. Final approval for the construction was given by the Federal Government December 11, 1942. If the project was to be completed before the 1943 rainy season, it was apparent that time could not be spared to make detailed surveys and prepare plans which are required before a project may be placed under contract. It was also apparent that if the project was contracted, it would be impractical to utilize the offers of the county supervisors and McDonald Logging Company for the use of their equipment and crews to be furnished at actual cost. It was, therefore, decided to do the work by day labor.

In general, the construction of the 20 miles of State highway consisted of: (1) the grading of a new roadbed to the surveyed line and grade for a width of 24 feet exclusive of side ditches and berms; (2) base treatment with mineral aggregate over the full width and 12 to 18 inches in depth; (3) surfacing with bituminous mix 22 feet in width and 3 inches in thickness.

The nine miles of county highway had been widened and surfaced the previous year with combined county and logging company funds but required some base reinforcement and a bituminous mix blanket 2 inches in depth and 22 feet in width throughout its entire length.

GRADING WORK RUSHED

As the project was designed to expedite the flow of logs and lumber to the war projects all work was planned toward that end. Surveys were begun January 7, 1943, and acquisition of rights of way, fence construction and clearing operations followed within a few days. Actual grading operations were started on January 19th. By April 19th, starting date of the lumber

Close-up views of heavily laden logging trucks on new C[illegible] [illegible] returning empty [illegible]

[illegible]

[illegible] and over the vari[illegible] haul roads.

[illegible] of the base and [illegible] the production haul [illegible] 000 cubic yards [illegible] Creek gravel [illegible] base construction on [illegible] miles, and lava and [illegible] on the upper or [illegible] portion. The latter [illegible] and shooting and [illegible] with heavy [illegible] to prepare for [illegible] the dump trucks. Power [illegible] were used for loading operations.

[illegible] HAULING PROBLEM

The hauling of material constituted the main problem. Although a large fleet of dump trucks made possible the [illegible] of this quantity of material [illegible] a period of only five and one-half months, conditions were made [illegible] the necessity of [illegible] the material over auxiliary roads containing a considerable amount of adverse grade running as high as 16 per cent. Securing a sufficient number of rented trucks for economical operation proved a major [illegible]. Trucks came and went, breakdowns were frequent, and it was extremely difficult to keep a full complement of trucks at work.

The 29 miles of bituminous surface required the producing, hauling, mixing and placing of 55,000 tons of mix, the aggregate consisting chiefly of decomposed granite. The surfacing was [illegible] two courses, the entire lower or leveling course and the finish course [illegible] the easterly 12 miles were road [illegible] with the use of a fleet of large motor graders.

[illegible] LOW COST

The [illegible] the finish course on the [illegible] 17 miles was produced at a [illegible] mix [illegible] plant at the low ready [illegible] cost of $1.50 per ton. Of [illegible] $1.15 was expended for [illegible] asphalt in the mix. The [illegible] represented the [illegible] the aggregate mix [illegible] loading into the [illegible] the grading of the [illegible] asphalt content averag[illegible] of the weight of the [illegible] required. Thirty-one [illegible] hundred fifty tons of [illegible] produced.

[illegible] spreading and [illegible] One [illegible] finishing machine [illegible] with a spreader box and motor graders. Both pneumatic and power rollers were used for rolling and compacting the surfacing throughout the entire project.

No small part of the operations was the supplying, heating, hauling and placing of the large quantity of liquid asphalt required in the road and plant-mix and surface treatment. A total of 5,000 tons, 1,200,000 gallons, of MC-3 liquid asphalt was used. One hundred and [illegible] carloads were shipped, the larger portion over the Southern Pacific Railroad to Ione and thence over 12 miles of branch railroad, Amador Central, to Martell. The asphalt was heated at this point and hauled in tank trucks to the job site. An additional 800 tons, equivalent to 20 carloads, were delivered directly to the site of the work by commercial tank trucks from the bay area.

RIGHT OF WAY DONATED

All work performed in connection with this project was under the direction of the District X Maintenance Department. The construction work and crew were supervised by Superintendent L. H. Kahl. Assistant District Maintenance Engineer Bert Lund and Assistant Engineer John S. Langenbach were in charge of the engineering. R. H. Lapp and Frank Lucas were Resident Engineers. The task of securing additional rights of way was accomplished by Frank Walker of the Division of Highways and donated by the property owners in a spirit of complete cooperation.

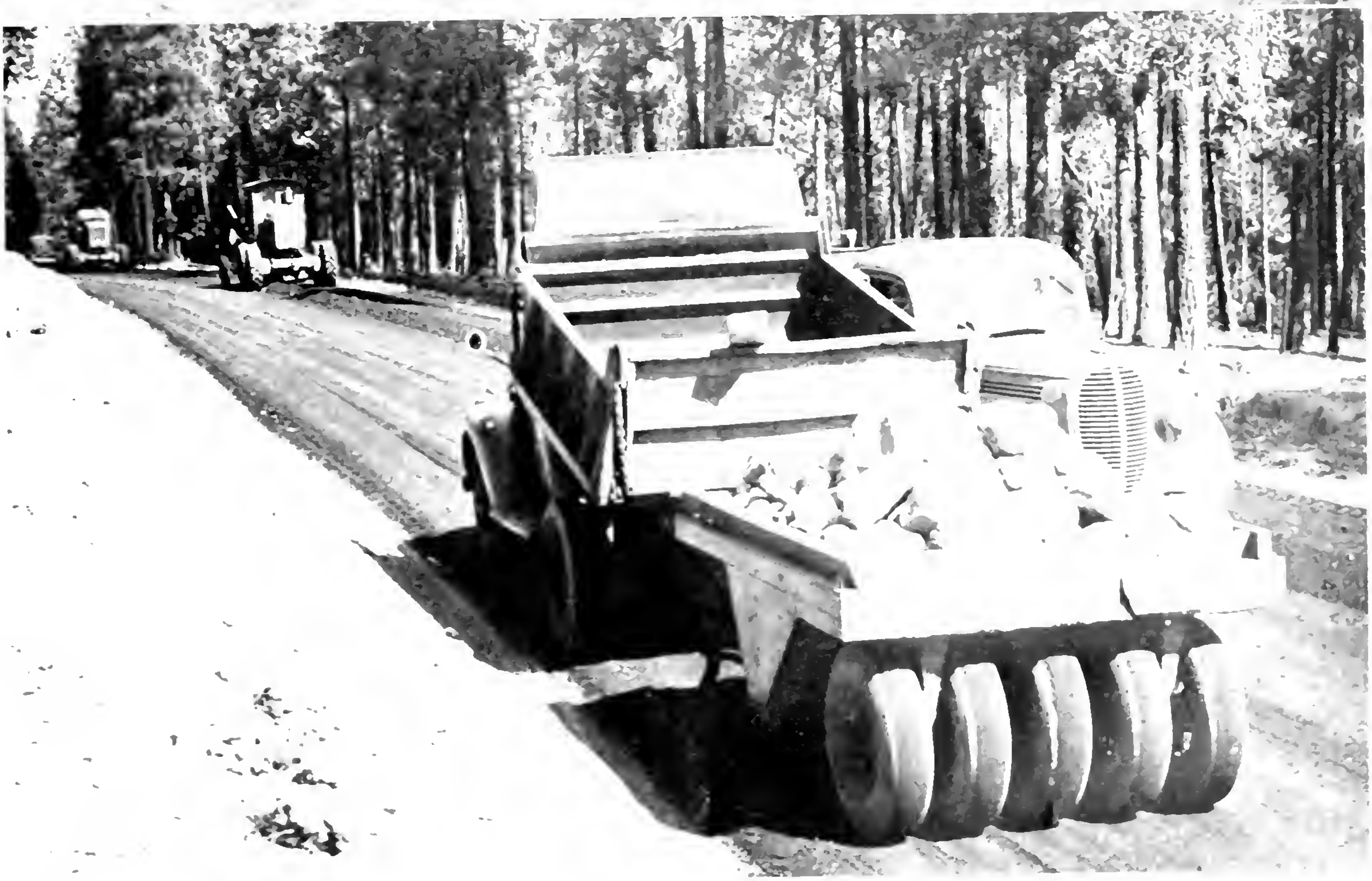
Excellent cooperation was also received from the Amador County supervisors under chairman Dan Ramazzotti and from the officials of the various lumber companies, especially J. T. McDonald of the McDonald Logging Company, and his superintendent, John Rukavina.

The completed highway, scarcely resembling the narrow, twisting road in existence at the beginning of the year, has accomplished the purpose for which it was built. It provides an all-year highway for the lumber industry, a road of sound base, modern bituminous surface, good alignment and grade, improved sight distance, and sufficient width for the safe passing of the heavy laden trucks.

INCREASED SPEED AND OUTPUT

The improvement has resulted in increased average speed of the trucks, and consequent greater daily output. This, together with the new all-year

(Continued on page 13)



At top—Easy going on 40,000 ... Bottom—...

State Highway Commission Approves 61 Projects

(Continued from page 1)

plant-mixed bituminous material, 0.8 mile.

Madera County, Route 4, portions between 0.5 mile north of Madera and county line; repair base, place plant-mixed bituminous material and seal coat, 6.8 miles.

Solano County, Route 7, portions between Route 8 and Fairfield; place rock base and plant-mixed bituminous material, 0.8 mile.

San Joaquin County, Route 5, portions between Tracy and Grant Line Road; repair base and place plant-mixed bituminous material, 3.0 miles.

SECONDARY NORTH

Mendocino County, Route 48, portions between Olsen Hill and east of McDonalds; place base course and seal coat, 4.4 miles.

Mendocino County, Route 56, portions between Navarro River and one mile south of Casper; place base course and seal coat, 3.9 miles.

Humboldt County, Route 20, from Junction Route 85 to Blue Lake, repair base, place plant-mixed bituminous material and seal coat, 5.4 miles.

Tehama County, Route 83, from Morgan Summit to Route 29; repair base, place plant-mixed bituminous material, 3.8 miles.

Sutter County, Route 87, portions between Tudor and Oswald; repair base and place plant-mixed bituminous material, 5.8 miles.

Contra Costa County, Route 75, from Broadway Tunnel to Orinda; repair base, place plant-mixed bituminous material, 1.8 miles.

Santa Clara County, Route 32, from five miles west of San Felipe to San Felipe; repair base, place armor coat, 5.0 miles.

Santa Cruz County, Route 56, portions between Santa Cruz and Davenport; repair base, place plant-mixed bituminous material and seal coat, 6.2 miles.

Contra Costa County, Route 75, from Route 106 to east end Willow Pass near Pittsburg; repair base and shoulders, place plant-mixed bituminous material, 2.3 miles.

Contra Costa County, Route 75, from near Pittsburg to 2.5 miles east and near Antioch to 2.5 miles east; place gravel base and plant-mixed bituminous material, 5.0 miles.

Fresno County, Route 10, portions between Oil King School and Huron Road; repair base, place borders, plant-mixed bituminous material and seal coat, 7.3 miles.

Fresno County, Route 125, portions between Kings County line and Caruthers; repair base, place borders, plant-mixed bituminous material and seal coat, 4.5 miles.

Stanislaus County, Route 110, portions between San Joaquin County line and Modesto; place rock base and plant-mixed bituminous material, 7.0 miles.

Stanislaus and Merced counties, Routes 41 and 32, portions between San Joaquin County line and Route 32 and between Los Banos and San Luis Creek; repair base and borders, place rock base and plant-mixed bituminous material, 23.5 miles.

San Joaquin County, Route 75, portions between Contra Costa County line and Stockton; place rock base and plant-mixed bituminous material, 5.0 miles.

Merced County, Route 123, portions between Route 32 and Merced; place rock base and plant-mixed bituminous material, 1.2 miles.

San Joaquin County, Route 53, portions between Potato Slough and Route 4; place rock base and seal coat, 1.9 miles.

PRIMARY SOUTH

San Luis Obispo County, Route 2, from 1.6 miles south of Cuesta to 1.7 miles north of Cuesta; repair base and place plant-mixed bituminous material, 3.3 miles.

Santa Barbara County, Route 2, portions between Alcatraz and Zaca; repair base and place plant-mixed bituminous material, 1.3 miles.

Santa Barbara County, Route 2, portions between Zaca and 1.5 miles south of Santa Maria; repair base and place plant-mixed bituminous material, 5.6 miles.

San Luis Obispo County, Route 2, portions between Santa Maria River and Arroyo Grande; repair base and place plant-mixed bituminous material, 1.5 miles.

Tulare County, Route 4, portions between Kern County line and Quail; repair base, place plant-mixed bituminous material and seal coat, 6.7 miles.

Orange County, Route 2, portions between San Diego County line and Galivan; repair base and shoulders, place plant-mixed bituminous material, 4.4 miles.

Los Angeles County, Route 23, portions between Solamint and Acton Road; repair base and shoulders, place plant-mixed bituminous material, 7.7 miles.

San Bernardino County, Route 58, Newberry to Hector; repair base and place bituminous material, 8 miles.

Kern County, Route 23, portions between Mojave and Cinco; place road-mixed bituminous material, 4.0 miles.

Kern County, Route 23, portions between Cinco and Ricardo; place road-mixed bituminous material, 3.0 miles.

Imperial County, Routes 12 and 27, portions between Dixieland and Holtville; repair base and place road-mixed bituminous material, 11.6 miles.

SECONDARY SOUTH

San Luis Obispo County, Route 33, portions between Paso Robles and Kern County line; repair base, place cushion course and plant-mixed bituminous material, 6 miles.

San Luis Obispo County, Route 56, portions between 0.8 mile west of Pennington Creek and Toro Creek; repair base and place plant-mixed bituminous material, 5.6 miles.

Kern County, Route 57, portions between Maricopa and Route 4; repair base, place plant-mixed bituminous material and seal coat, 11 miles.

Kern County, Route 140, portions between Kern River and Greenfield; repair base, place plant-mixed bituminous material and seal coat, 6 miles.

Kern County, Route 33, portions between Pumping Station and 2 miles west of Wasco; repair base, place plant-mixed bituminous material and seal coat, 16.5 miles.

Los Angeles County, Route 168, portions between Route 174 and Fawcett Avenue; repair base and shoulders, place plant-mixed bituminous material, 2.8 miles.

Los Angeles County, Route 79, portions between Route 23 and Route 4; repair base and shoulders, place plant-mixed bituminous material, 4.6 miles.

San Bernardino County, Route 190, portions between Etiwanda Avenue

(Continued on page 15)

23 Counties Receive $494,506.39 For Postwar Highway Construction

CALIFORNIA counties rapidly are taking advantage of the legislative act appropriating $1,-00,000 to be divided among the ounties for surveys, plans and specifiations for postwar county highway onstruction.

County budgets of proposed exenditures for these purposes aggreating $466,094.24 already have been pproved by Director of Public Works . H. Purcell.

The budget of 23 counties subnitted to the Department of Public Works according to law have been aproved and checks to finance the planned work have been drawn by the State Controller.

The act under which the $1,500,000 was appropriated provides that each ounty shall receive $5,000 and additional funds allocated on a basis of each county's motor vehicle registration as compared with the total motor vehicle registration of the State.

Counties whose budgets have been approved and the amount of money each has received are as follows:

Plumas	$6,537 65
Glenn	7,383 58
Stanislaus	19,650 00
Sacramento	36,411 79
Madera	2,600 00
San Mateo	25,853 82
Monterey	18,213 53
San Luis Obispo	11,940 00
Mendocino	8,732 34
Fresno	35,500 00
Tuolumne	6,505 10
Siskiyou	7,000 00
Alameda	67,520 28
San Bernardino	33,533 09
Merced	13,300 00
San Joaquin	28,873 00
Placer	8,807 00
Sonoma	18,567 32
Santa Cruz	12,534 07
San Diego	64,893 00
Sutter	8,396 11
Riverside	23 342 56
Kern County	28,412.15
	$494,506.39

The board of supervisors of Marin County has taken action to obtain $3,000 of its share of postwar planning funds which will be used to help finance a county survey for the proposed Sausalito approach to the Golden Gate Bridge.

In Memoriam

Edward M. Muse

On January 3, 1944, Edward M. Muse, former employee of Division of Highways, Central Office, passed away at his home in Sacramento, just five days prior to his seventieth birthday.

Mr. Muse retired from active service because of failing health on June 1, 1942. He entered the employ of the California Highway Commission on August 19, 1918, and served the State for nearly twenty-four years.

Mr. Muse was a man of unusual talent and artistic skill, and much of his work for the State will live for many generations. Most prominent among his permanent contributions to the State of California are the official seals which he designed for seven of the State Departments and the official emblem of the California State Employees Association. The State Departments whose seals are the result of Mr. Muse's handiwork include: the Department of Public Works, Division of Highways; Division of Forestry; Department of Motor Vehicles; California Highway Patrol; California Toll Bridge Authority; and California State Water Authority.

Mr. Muse supervised many of the exhibits of the Department of Public Works at State Fairs during the past twenty years. He also planned and promoted several projects for the beautification of the Capitol properties in Sacramento. The most ambitious of these was a proposed monumental arch as a Pioneer Memorial to be erected as an entrance to the Capitol grounds.

Another project which Mr. Muse conceived was a proposed series of large oil paintings depicting wild life scenes and historical episodes of early California. He executed the first of this series, and it now hangs beside the north staircase of the Capitol. The painting shows a bewildered faun standing beside the prostrate body of a doe killed by a careless hunter.

Mr. Muse was born in Greensburg, Louisiana, on January 8, 1874. He studied at the Art Students League and the Academy of Industrial Design in New York City. He came to California in 1904 and was employed in the commercial art field in San Francisco, Stockton and Sacramento prior to his employment by the State.

The sympathy of the Department is extended to Mrs. Muse and to his grandson, Edward Brock, now serving in the Army of the United States.

Lumber Output Increased By Rebuilding 29 Miles of Mountain Highway

(Continued from page 10)

program, will materially increase the lumber supply for the war effort. It will also prove of considerable value to the logging and lumber companies and the local communities, in that year-round work for experienced crews, rather than seasonal work, will be provided.

For many years, residents of Amador County and snow sports enthusiasts have pleaded for improvement of State Highway 88 over the scenic Kit Carson Pass. The new construction now provides the first modern link in this highway east of Pine Grove. The good grades and easy curves, the sharpest of which are safe for a speed of 35 m.p.h. by actual test, will surprise and delight the motorist on his first trip over this new highway.

LOCAL COMMUNITIES BENEFITED

The local communities of Amador County also received considerable financial help from this road construction through employment of local citizens previously made idle by the closing of the gold mines, by the expenditure of several hundred thousand dollars in these communities, by the shipment of the many carloads of oil over the locally-owned branch railroad, and indirectly by the aid rendered to its present chief industry—the lumbering business.

Thus the expenditure of $356,000 has built in one season 29 miles of good road of permanent economic and recreational value at moderate cost, has assisted local communities, and has contributed materially to the war effort.

Regrettably, this project cost the life of Angelo Puccini, a popular citizen of Amador County. During the performance of his duty as a flagman, he fell under the wheels of a large motor grader.

Tunnel Through San Vicente Dam Used During Relocation of Highway

By L. H. WILLIAMS, Resident Engineer

ONE of the major problems of all the southern California cities has been that of securing adequate water supply. The civic-minded leaders of the early San Diego days, realizing this, made long range plans to care for the community's increase in population, by adding additional units of supply to the water system, as they became necessary.

The plans for San Diego have always incorporated a chain of separate and interlocking lakes and reservoirs, to be constructed, or added, as the need for them arose, together with the possibility of bringing in water from the Colorado River by one of several feasible routes.

The unprecedented increase in the population of San Diego and vicinity, due to war activities, advanced the need for adding additional supply and storage units far ahead of the time originally contemplated.

HIGHWAY RELOCATION NECESSARY

The next logical unit to be added, after the completion of the El Capitan Dam across the San Diego River near Lakeside, was the San Vicente Reservoir across San Vicente Creek north of Lakeside, which was designed to store run-off from it's own watershed, and also to care for the surplus waters of the El Capitan Dam.

The utilization of the San Vicente unit involved the relocation of Highway 198, the Lakeside-Ramona road, a rather important link in the State Highway System of San Diego County. Satisfactory arrangements were made with all concerned, as to the financing of an alternate route to take the place of the one located within the area to be flooded by the construction of the dam.

As the plans for the dam began to materialize, the State started surveys and plans for the new highway location. Upon completion of several reconnaissance surveys, the most feasible route was found to be to the left, or west, of the dam and reservoir site.

From the bridge across the San Diego River, just north of Lakeside,

San Vicente dam under construction across highway showing hole left for traffic during road relocation. At bottom, the completed dam

the location follows closely an existing county road for about two miles. Thence it traverses new territory through rocky hills for about eight miles, to a connection with the Poway road.

It then follows the Poway road about one and two-thirds miles to a connection with an existing oiled road near the Mount Woodson State Ranger Station. This oiled road extends about three miles to a connection with the pavement on Route 198, and has been taken over by the State as a portion of the new location. The total length of the new construction is 11.67 miles.

HOLE LEFT FOR TRAFFIC

A contract to Clyde W. Wood, of Los Angeles, was approved April 10, 1942, and work on the highway started on April 27, 1942. Owing to low priority and scarcity of repair parts, t was difficult to keep equipment in repair, and also to keep a sufficient orce of men on the job. For these easons the work was not completed until December 29, 1943.

The contractor for the construction f the dam carried on his work in such manner as to have the existing highway open to traffic as long as possible. An opening through the base was left o permit passage of traffic while the lam was being constructed across the highway. (See accompanying photograph.) The handling of traffic in this manner was very successful, and accomplished with very little interference to the contractor's operations. The plugging of the tunnel presented ome interesting problems. This was ccomplished by means of a wooden patch placed over the upstream end nd the filling of the tunnel itself with concrete by means of pressure methods.

Owing to a heavy rain storm, and he prospect of being able to store considerable water before the winter was over, the tunnel was closed on January 3, 1943, by order of Army authorities. From that time on, the major part of he traffic was routed either through Escondido, or over the Barona Indian Reservation road, until late in the ummer, when it became possible to arry most of it on the new highway in ts semi-completed condition.

SEVEN PER CENT GRADE

The present highway is slightly onger than the old one, but is considerably improved in alignment. There are two curves of 400-foot radius, and one of 500-feet. The balance are of (comparatively) large radii. The maximum grade is 7 per cent, and is 1½ miles in length.

The roadway, from shoulder to shoulder, is 24 feet, and surfacing consists of 3 inches of road-mix, a portion of which is constructed on 1 foot of selected decomposed granite. Another portion is constructed on a 1½-foot depth of the same. On the balance, the native material of a granitic nature was used.

Drainage structures consist of metal and concrete pipes, there being included six 90-inch and one 105-inch multiplate pipes, as well as one 84-inch concrete pipe. Five of these pipes were paved and fences tied into them, so they could be utilized for cattle passes.

A total of 2,120 feet of guard rail was placed, and 570 culvert markers and guide posts to safeguard traffic.

The last one and two-third miles of the project replaced a portion of the Poway road which was very narrow and precipitous, being practically a one-way road.

The entire cost of the job, including engineering amounted to approximately $700,000.

Mile and a half stretch of 7 per cent grade on new highway through boulder covered hills

State Highway Commission Approves 61 Projects

(Continued from page 12)

and San Bernardino; place road-mixed bituminous material, 1.3 miles.

San Diego County, Route 77, portions between Escondido and north county boundary; repair base and place plant-mixed bituminous material, 4.2 miles.

San Diego County, Route 195, from 6 miles east of Oceanside to Route 77; repair base and place plant-mixed bituminous material, 3.0 miles.

San Diego County, Route 2, portions between San Ysidro and Chula Vista; repair base and place plant-mixed bituminous material, 1.7 miles.

Riverside County, Routes 187 and 203, portions between Thermal and Route 26; place road-mixed bituminous material, 9.8 miles.

The 24-foot roadway has few curves, only 2 of 400-500 foot radii

New Spotting Wheel Device for Marking Pavement Traffic Lines

By MARTIN A. O'BRIEN, Maintenance Assistant

THE OLD adage that necessity is the mother of invention is again exemplified by a new pavement marking wheel developed by the Maintenance Department. Manpower shortage coupled with rising costs and decreasing revenue prompted trial uses of devices to reduce the high cost of spotting the pavement preparatory to traffic striping.

The device consists of a trailer wheel and paint container attached to the rear of a truck with two pointers mounted by adjustable clamps on the truck's front bumper. The spotting wheel is attached to the rear bumper while the paint container is affixed to the tail gate. Paint drips by gravity onto the wheel which runs along the pavement, leaving a trail of white paint.

The present device, copied from a machine used in District VI, was made at headquarters shop from the verbal suggestions of the author. Credit is due the shop mechanics for the improvements incorporated in the unit, particularly to E. C. LaTour, Shop Foreman, and his assistant, Wm. J. Millard.

IMPROVED ON MODEL

The clamps and wheel attachment are adjustable so as to fit any model truck or passenger car. After a few trial runs over a rough surface, it was found necessary to tie the pointers more rigidly to the bumpers to eliminate "wobble." The tie rods, adjusted by turn buckles, stiffen the boom and allow for perfect alignment of the pointers.

The idea for this method of marking was borrowed from the Los Angeles County Road Department which made up a wheel several years ago to mark mountain roads. Our Highway District VI improved on this early model and have used it successfully for spotting.

The device made up by District VI consists of a spotting wheel and pointer in one unit, and is attached to the front bumper of a truck. Its use on tangents requires an operator of considerable skill and practice to obtain a straight line.

MARKING WHEEL AT REAR

With the marking wheel in front, each movement of the front wheels of the truck was indicated by the marking wheel. By placing the wheel in the rear, we found the painted line did not reflect the slight movements of the front wheels.

This also eliminated the necessity of having a workman ride on the fender to regulate the flow of paint. The rear attachment permits a workman to ride in the body of the truck as the paint control valve and wheel lifting lever can be operated from this position.

In installing the device, it is first necessary to line up the truck and driver's eyes along a painted line. The two pointers are then placed and carefully adjusted to this line. The marking wheel is then installed on the rear bumper directly over the center of the line.

PAINTS 3-INCH DOTS

At first a short trial run, using water instead of traffic lacquer, was made to test the adjustments. While the driving speed will vary with different operators and types of pavement, a speed of 10 to 12 miles per hour appears to give the best results.

In using the wheel device, guide points consisting of white painted dots (3 inches diameter) are placed at approximately 100-foot intervals.

When the guide line is to be followed by painting of the regular stripe within a short time (1 to 2 weeks), the lacquer may be thinned, using one-half paint and one-half thinner. If the line must serve for longer periods, a heavier application should be made. A satisfactory line was obtained by using one-third gallon of thinned lacquer per mile.

Cold water paint is not suitable for use with this device. It was found that it settled quickly and clogged up the valves and paint lines.

REPLACES ROPE METHOD

The method followed for many years consisted of stretching a rope between transit points set on a newly paved highway, and painting small marks on the rope at from 2- to 4-foot intervals. The resulting "cat-tracks" were used to guide the striping equipment.

In a normal working day approximately six miles of highway could be cat-tracked. The operation usually required three men, one at each end of the rope and one for marking, plus flagmen at each end of operations on heavily traveled routes. This method is hazardous as workmen are placed on the traveled way without any protection. As a matter of fact, the foreman of one of the traffic striping crews was recently struck by an automobile in an open desert area, and quite severely injured.

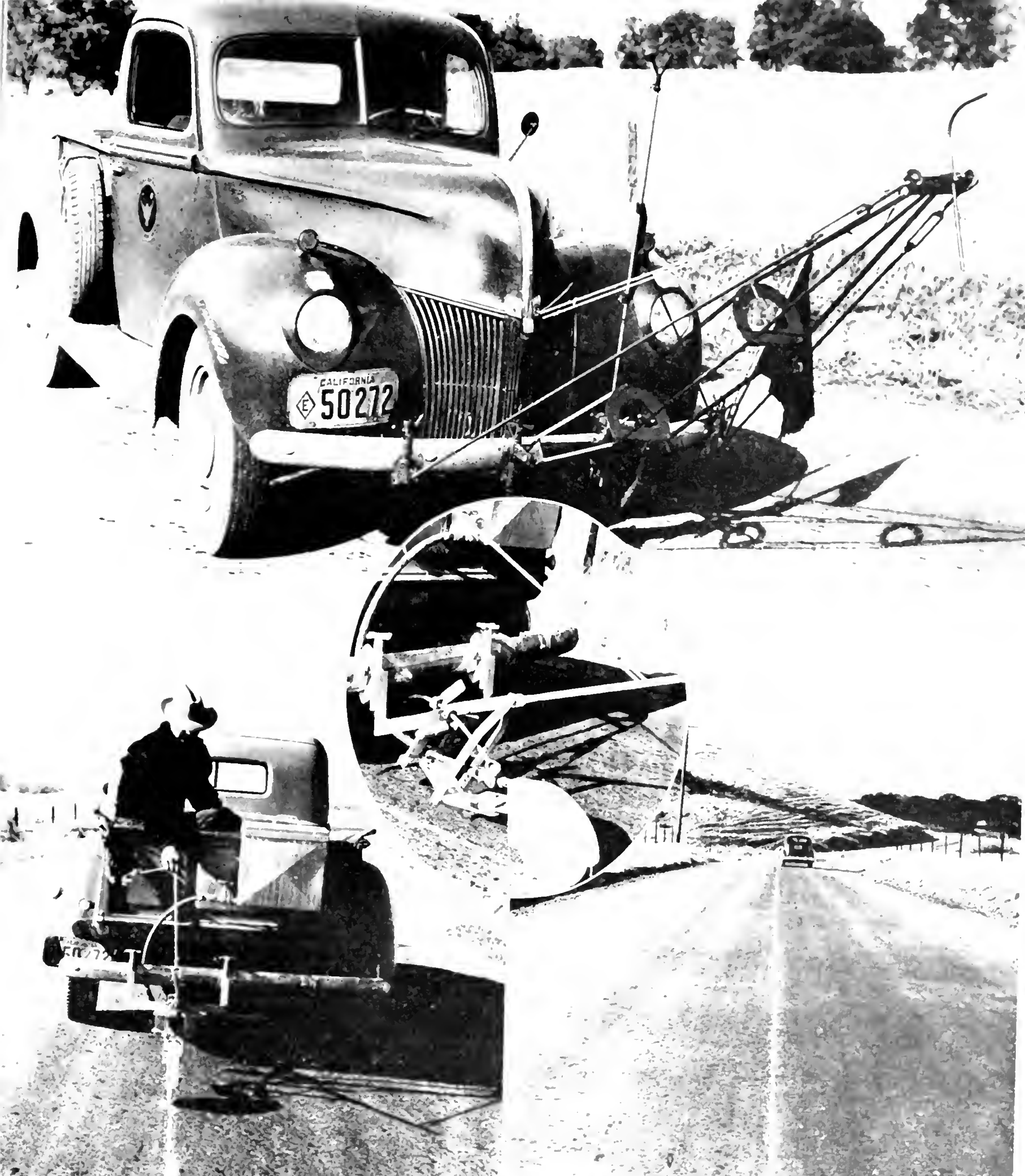
The new marking device makes a continuous white line, one-half inch wide, and if sufficient pavement is available, will spot 50 miles per day with a crew of two men. Frequently, on curves or winding roads, a pilot car precedes the truck doing the spotting to warn oncoming traffic.

LOW COST EFFICIENCY

By its low cost of operation, the new marking wheel permits the placing of a temporary traffic line on new pavements immediately after the surfacing is placed or is ready for traffic. Because of manpower shortage or distance involved in moving the paint crew, it was frequently necessary to defer the painting of traffic lines on new pavements.

This new device, easily mounted on any car or truck, makes it possible to mark all new blankets or seal coat jobs and give traffic the benefit of a temporary center line at a reasonable cost, particularly important on multiple lane highways.

Like all new devices, proficiency in its operation requires practice and a certain degree of skill in driving to insure a straight line. The results obtained are illustrated in the picture accompanying this article.



p picture shows pointer assembly attached to front bumper of truck enabling operator to follow a straight line. Center inset shows marking wheel attached to rear bumper and below workman controlling paint valves and wheel lifting lever.

Relation Between Right of Way and Freeway Design

(Continued from page 6)

be favorably developed, the rest of the location usually can be fitted satisfactorily.

At important intersections careful right of way plans must be laid out on the basis of ultimate development, regardless of initial improvement. Purchase of an area that will allow future elimination of traffic stream conflict is usually cheaper now than later when improvement has increased values. Purchasing access rights from abutting property on ramp approaches or interchange roads over distances sufficiently long so that the freeway entrances will never be choked by local interference, is good insurance.

We should make an inflexible rule which forbids combining an outer highway connection with a direct freeway entrance or with accelerating and decelerating lanes. This requires extra right of way area; it requires some additional purchase of access rights. It forces bulb returns at a freeway entrance so the outer highway is carried independently of the direct and channelized freeway entrance. Expensive corner property may occupy the bulb return area. Sometimes the whole connection can be more economically deflected to miss the corner lots, be brought to a point where the necessary area will not destroy so much improved property.

Separations can often be offset parallel to the existing cross street, getting new right of way cheaper than to purchase access rights along the existing lateral. The latter can then be used for outer highway connection or for inlets and outlets. Cooperative study between engineer and right of way agent has resulted in avoiding considerable cost and much local criticism along one of our routes where this principle could be applied repeatedly.

6. Border Treatment

Public utility facilities are not desired on a freeway and should not be permitted on the freeway proper. Where an existing highway carrying public utilities is incorporated in the freeway development every effort should be made to remove the utilities, at least to the outer highway. On new right of way a positive attitude can be maintained. The cost of additional right of way to accommodate public utility facilities on freeways is too great for the highway department to assume.

Some provision must be made for transverse crossing of utility lines.

Telephone lines that may legally enjoy the privilege of using public right of way, can be required to go to underground installation. Power lines should be denied. There are usually parallel streets available for their use.

The appropriateness of treatment and the character of development will determine the area required for landscaping or border treatment. A freeway is not always a parkway. It may, however, still be appropriately treated to satisfy esthetic taste with a minimum amount of right of way required for that purpose.

Sidewalks should not be permitted on freeways; they belong on the outer highways or on parallel streets.

General Observations

Everyone realizes the advisability of acquiring enough overall area for ultimate purposes—for some provision that may not be foreseen.

Be careful right of way estimates are reliable when the analysis is made. Ultimate satisfaction is more assured by adequate right of way than by doubtful expedients design must employ to make too much saving in width.

Right of way negotiations should be carried out by the agent in a frank discussion of the proposed highway plan. Disadvantages to property as well as the good points of the design should be disclosed if occasion requires. To so act, the agent must have a correct layout plan and must understand it. The engineer must have those plans advanced far enough to be reliably presented by the time acquisition is begun.

Considering the many steps and factors whereby the working design takes form through joint investigation and recommendation, it is evident both right of way and engineering personnel will have a mutual understanding in order to efficiently function. The preparation of freeway projects unfolds relatively new angles that can not be turned to advantage without collaboration.

Centralized coordinating personnel of a well organized highway department play an important part in smooth progress. Reviews and approvals, step by step in stages of advancing project preparation are necessary to comb out defects, standardize results and expedite completion.

No freeway project succeeds without cooperation of the other interests outside the highway department. Local support is helpful and necessary from inception to completion. The engineer and the right of way man can work best with those interests cooperatively. Together they can accomplish wonders. It is one thing to submit to local authorities a freeway map and freeway agreement. It is another to get their approval to the scheme of a limited freeway established across the heart of their metropolitan area, closing streets here, interrupting arterials there.

Finally we are fortunate in being fortified with a thorough understanding of the principles of good design this association has been so active in making available.

Postwar Disposal of 50 Billions of War Equipment

The following resolution relative to the orderly disposal of surplus war equipment by the government after the war was passed by the American Association of State Highway Officials at its recent convention in Chicago.

Whereas, It has been estimated that the surplus of war equipment and supplies at the end of the war will have a cost value of at least fifty billions of dollars; and

Whereas, The disposal of this surplus should be made with the least possible loss to the Government and at the same time, the least disruption to our private enterprise system; and

Whereas, It will benefit the economy of the Nation if there be a distribution of road building and maintenance machinery on a "Lend Lease," "Direct Sale," or other suitable basis to those counties whose road programs have been slow in developing; and

Whereas, Such programs will create a market for United States made equipment as well as a market for United States Engineering talent; now, therefore, be it

Resolved, That this association favors the orderly disposal of surplus war equipment at the least loss to the Government and the greatest benefit to the National economy; and be it further

Resolved, That the Committee on Maintenance and Equipment of the American Association of State Highway Officials be requested to study the question and make recommendations to our Legislative Committee for its use before the Congress; and be it further

Resolved, That copies of this resolution be sent to the Roads Committee of the Senate and the House.

Highway Bids and Awards for December 1943 - January 1944

ALAMEDA COUNTY—On Washington venue, between San Leandro and San Loenzo, about 1.3 miles, drainage pipe to be istalled. District IV, Route 69, Section B. adich & Brown, San Leandro, $31,349; ouis L. Fitinghoff, San Jose, $36,890; Meuire & Hester, Oakland, $38,472; Oakland ewer Construction Co., Oakland, $42,233. ontract awarded to McDonald & Kahn, Inc., an Francisco, $33,845.

IMPERIAL COUNTY—Between State ighway Route 12 at Seeley and Camp eeley, about 1.4 miles to be graded, gravel ise material to be furnished and placed, and oad-mix surfacing to be placed thereon. District XI, R. E. Hazard & Sons Contracting o., San Diego, $26,115; Macco Construction o., Clearwater, $41,458. Contract awarded Arthur A. Johnson, Laguna Beach, 21,949.

KERN COUNTY—Across Rag Gulch, bout 1.5 miles south of Tulare County line, reinforced concrete box culvert to be conructed. District VI, Route 129, Section B. riffith Co., Los Angeles, $14,914; Kiss rane Co., El Cerrito, $16,620; Rexroth & exroth, Bakersfield, $11,585; Vinnell-Engieers, Ltd., Alhambra, $11,983; C. B. Tuttle, Vilmington, $12,780; James B. Allen, San arlos, $12,380; Rand Construction Co., akersfield, $11,733; Wm. E. Thomas Conrete Construction, Maricopa, $9,804; J. E. laddock, Ltd., Pasadena, $11,433; Trewhitt, hields & Fisher, Fresno, $10,769. Contract warded to F. Fredenburg, South San Franseo, $9,317.

LOS ANGELES COUNTY—Figueroa treet between Adobe Street and Riverside rive to be surfaced with asphalt concrete nd plant-mixed surfacing. District VII, loute 165, Section A. Griffith Co., Los Aneles, $31,601. Contract awarded to Vido Kovacevich, South Gate, $26,311.

MONTEREY COUNTY—Across Torre anyon, Vicente and Limekiln Creeks beween 38 and 56 miles south of Monterey, hree bridges to be repaired. District V, Route 56, Sections C,E. A. A. Tieslau & on, Berkeley, $31,390; Earl W. Heple, San ose, $40,300; L. M. Sommer & Co., San 'rancisco, $33,276; Fred D. Kyle, Los Aneles, $34,610; James B. Allen, San Carlos, 34,854; James H. McFarland, San Franisco, $29,977. Contract awarded to Kiss rane Co., El Cerrito, $24,525.

RIVERSIDE COUNTY—On Arlington venue between Van Buren Street and Magolia Avenue in the city of Riverside, about .0 miles, to be surfaced with plant-mixed urfacing. District VIII. Matich Bros., Elsinore, $82,368; Phoenix Construction Co., Bakersfield, $89,118; J. E. Haddock, Ltd., Pasadena, $93,801; Tomei Construction Co., Van Nuys, $106,702. Contract awarded to George Herz & Co., San Bernardino, $74,687.

SAN DIEGO COUNTY—In National ity between Concrete Ship Constructors ard and National Avenue (State Highway Route 2) via 19th Street, McKinley Avenue nd 13th Street, about 1.4 miles, to be graded nd surfaced with plant-mixed surfacing. District XI. R. E. Hazard & Sons Contracting Co., San Diego, $48,860; Griffith Co., Los Angeles, $50,131. Contract awarded to V. R. Dennis Construction Co., San Diego, 46,347.

SAN FRANCISCO CITY AND COUNTY—On Donahue Street and Jerrold and Kirkwood Avenues, about 0.3 mile, to be graded nd paved with portland concrete cement on rushed rock base and armor coat to be aplied. District IV. Hunter's Point. Chas. L. Harney, San Francisco, $17,802; M. J. Lynch, San Francisco, $20,939; A. G. Raisch, San Francisco, $22,416; MacDonald & Kahn, Inc., San Francisco, $22,840; Peter Sorensen, Redwood City, $25,872. Contract awarded to Eaton & Smith, San Francisco, $16,102.

SAN JOAQUIN COUNTY—Bridge to be constructed across south branch Main Canal, 1.7 miles west of Route 4, junction. District X, Route 53, Section C. Wm. E. Thomas Concrete Construction, Maricopa, $6,390; F. Kaus, Stockton, $6,600; Baty Rocca, Stockton, $7,160. Contract awarded to James H. McFarland, San Francisco, $5,042.

MARIN SONOMA COUNTIES — Between 1.5 miles and 12.5 miles south of Petaluma, five existing timber cattle passes to be replaced with new reinforced concrete sections. District IV, Route 1, Sections A,C. Earl W. Heple, San Jose, $25,958; Kiss Crane Co., El Cerrito, $27,885; Mercer, Fraser Co., Eureka, $28,376; Stolte Inc., Oakland, $31,425; W. Lenkeit, San Francisco, $31,954; James B. Allen, San Carlos, $33,370; A. A. Tieslau & Son, Berkeley, $33,461; Lord & Bishop, Sacramento, $33,891; Helwig Construction Co., Sebastopol, $36,500; Peter Sorensen, Redwood City, $37,116; Trewhitt, Shields & Fisher, Fresno, $37,576; A. Soda & Son, Oakland, $38,722; Stockton Construction Co., Stockton, $39,760; Moore & Roberts, San Francisco, $41,441; E. A. Forde, San Anselmo, $51,135. Contract awarded to Wm. E. Thomas Concrete Construction, Maricopa, $24,334.

SACRAMENTO COUNTY—At the intersection of 12th Street and 16th Street, a traffic signal system to be furnished and installed. District III, Route 3, Section B. C. D. Draucker Co., Los Angeles, $7,379; Holdener Construction Co., Sacramento, $6,508. Contract awarded to Lippen & Hawley, Inc., Sacramento, $6,124.

SAN BERNARDINO COUNTY—At Blue Cut about five miles northwest of Devore, heavy stone riprap to be constructed. District VIII, Route 31, Section B. Shannahan Bros., Inc., Huntington Park, $77,330; John Strona, Pomona, $77,970; Geo. Herz & Co., San Bernardino, $83,670. Contract awarded to Norman I. Fadel, North Hollywood, $45,690.

Central Valley Project Scenes Shown in Technicolor

The motion picture in color "Central Valley Project" has recently been shown at meetings of the California State Grange at Woodland and Stockton and at a meeting of the Sacramento Printing House Craftsmen.

This picture depicts the various stages of construction of the project by showing Shasta, Keswick and Friant dams, relocation of the State highway and the railroad around Shasta Reservoir, and the Contra Costa and Madera canals. It likewise shows many irrigation works completed with scenes of some of the State's agricultural crops.

This film was prepared and was shown under the auspices of the Water Project Authority of the State of California.

In Memoriam

John James Stockard

The sudden passing of John J. Stockard, Associate Highway Engineer, on November 4, 1943, came with a sense of real and personal loss to his many friends in District IV and throughout the entire department, where he was so well known for over a quarter of a century.

Born in Springfield, Missouri, on October 30, 1875, he received his early education in the public schools and Cottey College of that State and Vanderbilt University at Nashville, Tennessee.

He married Edna M. Busby in August, 1903, and taught in Cottey College (founded by his mother) until 1907, when his urge for the outdoor life of an engineer became too strong to resist. From 1907 to 1913, he was employed in the construction and maintenance of various railroads in Utah, Missouri, and Oregon. He and his wife came to San Francisco from Salt Lake City on a projected vacation back to the old home in Missouri. Upon their first view of San Francisco, on September 2, 1913, from the deck of a ferryboat, he remarked, "This is it!", and the vacation plans were changed! Only a month later, on October 3, 1913, he was appointed an Assistant Resident Engineer in District IV. Since then he was promoted several times and filled many responsible and varied positions, in District I and District IV, throughout his thirty years of service.

Stanton and Harris Win Engineering Awards

THOMAS E. STANTON, Chief of the Materials and Research Department of the Division of Highways, has been awarded the Norman Medal, the highest award of the American Society of Civil Engineers, in recognition of an original paper on "The Expansion of Concrete," as an especially notable contribution to the Engineering profession, it was announced by George T. Seabury, secretary of the society.

Mr. Stanton has been with the Division of Highways for 31 years. He was one of the founders and first State President of the California State Employees Association. He is president of the Board of Administration of the State Employees' Retirement System.

Major Milton Harris, a member of Sacramento Section and an employee of the Division of Highways before entering the service, was awarded the Arthur M. Wellington prize for his paper on "Traffic Engineering as Applied to Rural Highways."

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A. S. H. O. Urges Aid B[y] Federal Works Agency

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WHEREAS, The construction [of] public works by the Federal Government and by State and local agencies will be an important factor [in] meeting the employment problem; and

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Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

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CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California | PRINTED IN U.S.A.

C. H. PURCELL, Director | GEORGE T. McCOY, State Highway Engineer | J. W. HOWE, Editor | K. C. ADAMS, Associate Edito

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Great Importance of the Federal Aid System and the Need for its Improvement

By C. H. PURCELL, Director of Public Works and Chairman of California Highway Commission

The following article is a paper presented before the Road Committee of the House of Representatives in Washngton March 2d, by Director of Public Works C. H. Purcell representing the American Association of State Highway Officials at a hearing on the Robinson Bill providing a Federal appropriation of one billion dollars a year for three years to mprove the highways of the Nation as recommended by the A. A. S. H. O. The subject of the paper was assigned to Mr. Purcell by the Executive Committee of the Association.

THE United States has spent the last 30-odd years developing roads and highways to serve he Nation's transportation.

The results of this effort are evident n the 478,000 miles making up the everal State Highway Systems, in the ,400,000 miles of county and township rural roads and in the 300,000 niles of city streets.

A considerable portion of the 2,400,000 miles of rural county roads has ad little improvement. While most f the State highway mileage has had ome degree of improvement, this mproved mileage is in various states f repair and a notable portion now eeds replacement or further improvement.

It is also most probable that the State Highway Systems are subject to expansion up to some 10 per cent to 20 per cent by inclusion of some of he more important county routes which are not distinctly land-use oads.

55% HIGH TYPE

Of the 478,000 miles of State highways, 433,000 miles are improved. These improved State highways represent almost 91 per cent of the total niles in the State systems. However, t must be understood that these "improved" State highways include 170,000 miles where the "improvement" is ess than low cost bituminous mix surface and 263,000 miles are medium or high type pavement.

Thus, of the total 478,000 miles n the State Highway Systems, which are supposed to represent the best in road development in the various States, only 55 per cent have been improved to standards of intermediate and high type pavements.

To reach this minor degree of development, it is estimated that since 1910 approximately 25 billion dollars have been expended on designated State highways, city streets and county rural roads, exclusive of relief expenditures. Of this amount it is definitely known some 12 billion dollars have been expended on the several designated State Highway Systems.

It is estimated that the total annual motor travel in the United States approximates 292 billion vehicle miles. Of this amount approximately 150 billion vehicle miles is generated on rural roads and 142 billion on urban roads. Recent studies by the Public Roads Administration show that on the main rural roads of the Nation, primarily the several State Highway Systems and comprising about 12 per cent of the total rural mileage, is generated 72 per cent of the total vehicle miles of travel.

CARRIES HALF THE TRAVEL

The Federal Aid Highway System of approximately 226,000 miles comprises but 7.7 per cent of the total National road mileage. The composition of the Federal Aid System is such, however, that most of the Nation's important and heavily traveled routes are included in it, with the result that on this 7.7 per cent of road mileage is generated 56 per cent of the total vehicle miles traveling the Nation's highways. In other words, the Federal Aid System is only one-thirteenth of the Nation's road mileage and yet it carries well over one-half of the Nation's travel.

When the composition of the Federal Aid System is considered, this condition is not surprising. The Federal Aid System was primarily designed to insure improvement of the more important routes within each State and to provide for correlation of such improvement between States. The result approaches an articulated National Highway System largely connecting the important areas and principal population centers of the Country.

That the selection of routes in the system has been well done, is evidenced by the laying out of subsequent road systems on a National scale. In determination by the War Department of the 79-thousand-mile strategic highway network, it was found that practically all roads selected were located on the Federal Aid System.

INCLUDES OTHER ROUTES

The status of the Federal Aid routes resolves itself into the backbone of the Nation's highway transportation system, comprising the Country's most heavily traveled routes, both as regards to trucking and passenger traffic. It includes within itself most of the proposed interregional routes; the military strategic highway network; principal interstate connections; and main intrastate highways.

From 1917 to 1943 the total amount of Federal Aid and emergency highway appropriations was $3,745,000,000. This does not include WPA or similar relief allocations. It is estimated that State funds used to match these Federal appropriations, amount to considerably more than an equal figure, so that it may be stated that total expenditures on Federal Aid routes since the inception of the system will total to between 8 and 9 billion dollars.

EXCISE TAXES DIVERTED

At this point your attention also is directed to the fact that during the eleven years between July 1, 1932, and June 30, 1943, more than $4,200,000,000 was collected in Federal excise taxes levied against the Nation's motorists. During this same 11-year period the total of Federal Aid and emergency funds apportioned to the several States amounted to $2,500,000,000. This shows, therefore, that more than 40 per cent of the Federal taxes collected on gasoline, tires, automobiles, trucks and parts, and the $5 use tax were diverted from road purposes.

However, improvements accomplished by expenditure of the Federal and State funds are extensive, but there has been no time during the 26 years when the Federal Aid System was completely adequate for the traffic it carried. Developments in automotive transportation have been so rapid during the past 30 years that road builders have been unable to keep their improvements abreast of the phenomenal advances in mechanical equipment.

Radical changes in motor transport may be consummated in a season. Major changes in road and bridge design will require two years or more between inception of the idea and completed construction. Under this handicap the highway engineer has worked at a great disadvantage. However, this lag between the development of motor equipment and highway design is being shortened through cooperation between manufacturers' organizations and road designers.

SURVEY SHOWED DEFICIENCIES

The extent of the discrepancies between highway construction and traffic needs on the Federal Aid System may be gauged from the survey in 1940 by the Public Roads Administration relating to the 79,000-mile Strategic Highway Network. Practically all of this network is located on the Federal Aid System and includes about one-third of the total Federal Aid mileage. Data compiled in this study showed that:

5,500 miles of road surface were less than 18 feet wide;

14,000 miles of road surface needed to be strengthened;

Of the 16,000 bridges on the network, the load capacity of 1,800 was less than 15 tons; the horizontal clearance of 1,700 was less than 18 feet; and on 150, the vertical clearance was less than 12½ feet.

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Survey Revealed Inadequate Roads

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A most optimistic appraisal of these data would indicate that the road surfaces and bridges on the strategic network are only about 75 per cent adequate, and on the remaining two-thirds of Federal Aid System the percentage of adequate improvement must be less.

It is quite apparent, therefore, that Federal Aid funds heretofore appropriated, together with State matching funds and State funds expended entirely without Federal assistance on the Federal Aid System, were totally insufficient for development of the system to standards needed by the traffic it is required to carry. On the basis of past expenditures of both Federal and State funds it is estimated that it would require eight or nine years to bring the Federal Aid System to acceptable present-day standards.

APPROPRIATIONS INSUFFICIENT

During the six years prior to the war, the States and the Public Roads Administration, working cooperatively, completed comprehensive rural road studies through the several Highway Planning Survey organizations. The work of this survey in each State included compilation of complete road and traffic inventories and analyses of the data obtained have been translated into highway needs.

By 1941 the States, with this definite knowledge of their highway needs, were on the way to well-organized planning for progressive development of their several road systems, with primary emphasis on main routes, including the Federal Aid System.

With the entry of this Country into the world conflict and the turn of the Nation to an all-out war effort, it was necessary to defer active road development on all projects not directly connected with the successful prosecution of the war. While this deferment of normal highway construction is a necessity during the period of the war, the result of the enforced inactivity will have far reaching effect upon the Nation's highways.

DETERIORATION INCREASING

Through lack of new construction and renewal by reconstruction the rate of obsolescence of road surfaces and bridges is rapidly increasing. Curtailed maintenance operations, in consequence of lack of manpower, materials, equipment, and equipment parts, coupled with wartime increases in heavy truck and bus traffic are resulting in greater deterioration of both structures and roadways.

On the Federal Aid System, the only construction undertaken during the past two years has been at locations where Federal access road projects, requested by the military, have happened to be on the system. Such instances have been comparatively few. Otherwise, practically all work that has been

(Continued on page 11)

Major Highways Blocked by Heavy February and March Snowfalls

By MARTIN A. O'BRIEN, Maintenance Assistant

THE winter of 1943-1944, while resulting in a moderate snow pack on the Sierra Nevadas, caused the first serious closure of U. S. Highway 40 over the Donner Summit since 1938. This occurred during the weekend storm of March 3d and 4th at a time when the official weather bureau records showed only 15 inches of new snow.

Two weeks earlier a similar storm in Southern California blanketed the Ridge Route under five feet of snow and resulted in the closure of U. S. Highway 99. With the exception of short periods when these two routes were intentionally closed for the safety of traffic, they had not been blocked for six years.

The closing of a major highway is unpleasant for everyone concerned. That it can happen is only another example of the limitations of man when pitted against the forces of nature.

Two big truck units stalled on Ridge Route section of U. S. 99 between Los Angeles and Bakersfield when heavy snowstorm closed the highway for three days

ON OTHER HIGHWAYS

The following snow falls were reported on other main highways during these same storms, but none of these routes were closed:

U. S. Highway 395 in Mono County	4 ft. of new snow
Highway 36—Red Bluff to Susanville	8 ft. of new snow at Morgan Summit
Highway 24—Feather River Route	3 ft. of new snow on Spring Garden Summit
Highway 89 at McCloud	8 ft. of new snow
U. S. Highway 299—Redding to Alturas	44 in. of new snow on Hatchet Mountain
U. S. Highway 99 at Mt. Shasta City	30 in. of new snow

Immediately upon the outbreak of war, the military authorities requested our cooperation in keeping the strategic and transcontinental routes open throughout the winter months. Until the storm of March 3d and 4th, U. S. 40 had been open every day since the winter of 1938.

To a convoy of trucks bound from the east to some California port of embarkation, its closing means a delay in shipment of war materials; may cause a ship to sail without essential cargo, or postpone the sailing time, with the possibility of goods reaching our fighting front too late.

In the past the unexpected closing of such a highway often resulted in trucks and other vehicles becoming stalled in the snow, usually without heat or food.

RADIO CONTACT MAINTAINED

The Division of Highways installed two-way short-wave radio communication equipment in maintenance stations and on snow plows several years ago, in all areas affected, to handle emergency matters such as breakdown of equipment. When ice, visibility or other storm conditions indicate traffic hazard, the control gates are closed and the Highway Patrol is notified to stop traffic.

The following traffic control measures are customary in snow areas: (a) Trucks are usually stopped first when snow or ice cause a slippery pavement as they too often get out of control and jackknife across the road, blocking it to further traffic; (b) One-way controls established and (c) closing the highway to all traffic.

For this purpose gates have been installed on U. S. 40 at Baxters and Donner Lake and at the Ridge Route Maintenance Station and Grapevine on U. S. 99. Traffic to and from Los Angeles over the Ridge Route is also stopped in advance of the snow area at Castaic and Greenfield as at these points alternate routes, via Mojave and Ventura are available.

SNOW EQUIPMENT AVAILABLE

Several years ago the Division of Highways constructed maintenance stations, one at Donner Summit, with others at convenient locations along U. S. 40, especially designed to house men and equipment and to allow for servicing and repair of the snow removal equipment. During the winter months each station is staffed with

Upper photo shows result of snow clearing work on Mineral Summit of State Route 29
Below a busy scene where motorists stopped to put on chains at Donner Summit of U. S. 40

trained and experienced men drawn from other points in the district.

Some of the trucks and snow equipment are over-aged, having been in service for more than ten years. These can be maintained in good repair only under very adverse conditions. New equipment can not be purchased due to war time restrictions and many spare parts can not be obtained and must be made in the Highway Shops.

It, therefore, soon became apparent that if essential service on major highways was to be provided, snow plows would have to be taken from roads in recreational areas, as stand-by equipment, for use in the event of a breakdown or unusual storm conditions. Breakdowns of equipment in service have occurred this year in nearly all snow removal areas, and the wisdom of this plan has been justified.

SNOW CLEARING PROCEDURE

Snow removal equipment works continuously during a storm and unless the snowfall is very heavy or visability is seriously restricted, the plows can remove sufficient snow to permit full or limited use of the road. At the beginning of a snow storm, push type plows start working as soon as an appreciable amount of snow covers the pavement. These plows push the snow into windrows at the pavement edge and are followed by the rotary plows which pick up the snow and throw it over the side.

The area of heavy snow on U. S. 40 is between Baxter and Donner Lake, a distance of approximately 32¼ miles. Within this area eight push plows and seven rotaries are available. Every piece of equipment on hand was used for the storm that began at 5.30 a.m. on Friday, March 3d, and which continued almost unabated until 7.30 a.m. on Sunday, March 5th.

DEVELOPED BLIZZARD VELOCITIES

This storm developed into blizzard proportions with wind velocities up to 50 miles per hour. The snow-filled air so restricted vision that the equipment operators could not see. In fact, visibility approached zero for several hours. Notwithstanding the efforts of the maintenance crews which kept the road open for the first 23 hours of the storm, it closed at 4.30 a.m. on Saturday, March 4th.

By 11 o'clock that night a one-way road was temporarily opened and convoys of stranded cars and buses followed a snow plow out of the area. The road then remained closed until a m Sunday, March 5th, when it was gain opened to cars and buses equiped ith chains. Trucks were not permitted travel until 8:30 a m. when they ere released at 45 minute intervals. hese restrictions were lifted at 12 oon.

The highway was first closed near lue Canyon. At this point the aveled way follows a ridge for approximately two miles and is in a very posed position, unprotected by trees. uring high wind velocities, the snow rifts at a high rate.

The maintenance crew working is area reported that at times the ow drifted on the pavement became 2 ft. deep. One of the rotary plows ade no forward progress for one our, but continued to remove snow om a standing location.

DRIFTS STALLED PLOWS

The following comments offered by e maintenance crews working in this ea may further explain the difficules experienced. On February 28th d 29th, 46 inches of light, dry snow ll at Donner Summit. By March 1st, e road was completely widened. The ow, however, did not crust over and hen the wind velocity increased on arch 3d and 4th, much of this dry ow drifted into the cleared area of e highway and added materially to e difficulties experienced during this eriod.

During the storm of the 3d and 4th, rifts and slides were encountered om 60 to 144 inches in depth on the oadbed. From 12.01 a.m. until 8 .m. on March 4th, numerous snow lides occurred on the grade from onner Summit to Donner Lake. It equired the continued use of two nogos to maintain a one-way road rough this 3.3 mile section. At 3 .m. on March 4th three push plows ecame stuck in snow drifts, one-half ile west of Donner Summit, with 0 to 80 inches of snow on the road. hese plows were removed from the rifts by a Snogo at 8 a.m.

Further west, near the Blue Canyon irport, several vehicles were unexectedly trapped at approximately .30 a m. on March 4th. Five large ransport trucks and four passenger ars headed west, and three transports, our Greyhound buses and four passener cars headed east became stalled, in ddition to one of the push plows that ad failed mechanically.

(Continued on page [illegible])

Push plows of several types shown in the two upper photos aided by a rotary plow kept State Highway 36, the Red Bluff-Susanville lateral, open during an 8-foot snowfall on March 3d to 5th

Laboratory Builds a Profilograph to Measure Pavement Roughness

By F. N. HVEEM, Senior Physical Testing Engineer*

ONE of the primary purposes in building a highway is to provide a vehicle path which is more smooth and uniform than the original ground. As a consequence highway engineers have placed considerable emphasis on the surface smoothness of the roadway and from time to time have devised equipment to measure and evaluate pavement roughness.

One of the first of these devices was an instrument known as the vialog developed by the New York State Highway Department which was mounted in a car and actuated by the vertical oscillations of the front axle as the car is driven over the road. A modification of this apparatus is still in use in California and is generally known as a roughometer or "bumpometer."

The roughometer device on a car indicates pavement roughness by summarizing on mechanical counters the vertical movements of the front axle of the car and hence the final totalized values do not differentiate between a number of movements of small amplitude as compared to fewer bumps of greater size. In other words while some idea of total roughness may be gained it is impossible to identify the kind or variety of roughness.

PREVIOUS DEFICIENCIES OVERCOME

In order to study highway pavements and to correctly understand the variations in pavement contours due to the effects of traffic, moisture and temperatures, it is necessary to develope a profile on paper which will enable the engineer to visualize not only the magnitude and frequency of pavement inequalities as they affect motor vehicles, but the approximate shape or contour as well. Several devices of this sort have been constructed. One, described in a report of the Road Research Board in Great Britain in 1936, pictures a device with a series of 16 wheels connected by an intricate tubular frame. The entire apparatus appears to have an overall length of some 25 feet.

It is also reported that following the first World War the State of Wisconsin constructed a somewhat similar apparatus using a large number of bicycle wheels. California Highways for December, 1939, carried an article describing a viagraph constructed in District VII and designed in the Los Angeles County Road Department by Mr. C. F. Galloway.

NOT MOUNTED ON AUTO

Most of the units thus far constructed seem to have certain disadvantages which may be analyzed as follows: An instrument mounted in an automobile actuated by movements of the car axle does not reflect pavement contour truly, but is a composite value depending on the spring suspension and riding characteristics of the individual car.

The elaborate multiple wheel units such as used in England are very cumbersome and would be difficult to transport for long distances. The type of apparatus using only three wheels does not produce a true profile record as many pavement inequalities are canceled out, others are amplified or multiplied in number.

In designing a profilograph for use by the Materials and Research Department in California an attempt was made to satisfy the following conditions or requirements:

REQUIREMENTS FULFILLED

1. The instrument should have a length or "wheel base" approximately the same as a typical automobile in order that the pavement roughness should be recorded with reference to a motor vehicle plane and not with reference to a continuous plane.

2. The instrument should be supported by a multiplicity of wheels, at least 16, mounted on compensating axles in order to provide a datum plane of about the wheel base of an average car parallel to the local pavement contour but which would be virtually independent of minor inequalities.

3. The equipment should be collapsible and capable of quick assembly and when collapsed, should be compact enough to permit transportation in an ordinary sedan car.

4. Preferably, the instrument should not require special paper with either rulings or perforations. Such paper is expensive and if plain paper rolls similar to that used in commercial adding machines could be utilized a considerable saving would result.

CONTROLLED BY OPERATOR

5. The operator should be in a position to observe the graph at all times during the process of recording and the recorder should be available for remarks or notation on the paper strip.

6. The operator should be able to steer the profilograph in order to select and follow a predetermined path.

7. The frame should be very rigid and free from any tendency to sag or "spring" while in operation.

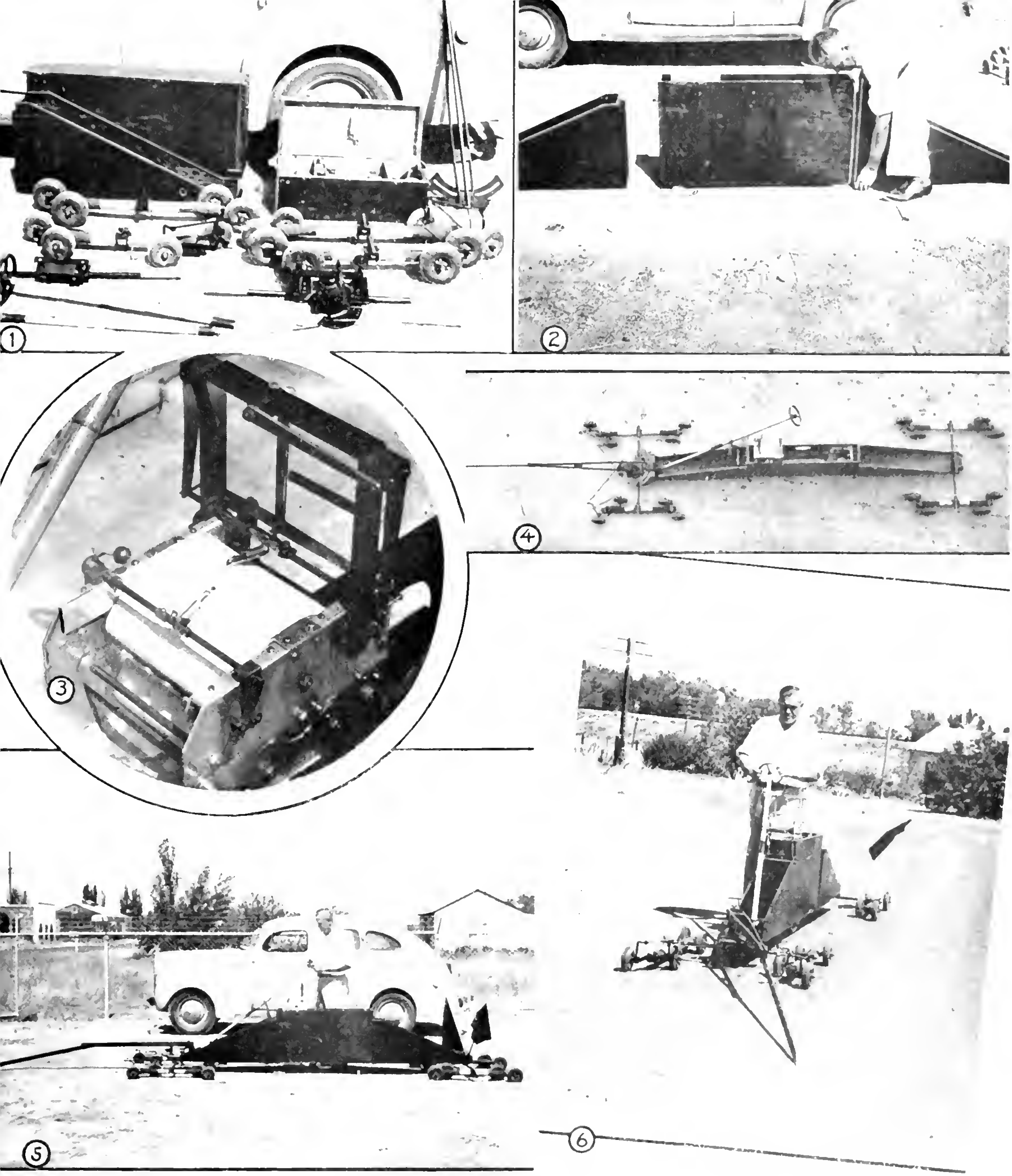
Accompanying sketches and photographs indicate the manner in which these conditions are satisfied. Sixteen small pneumatic-tired wheels were provided, each of which is free to move independently in a vertical plane. These carrier wheels are fixed in a staggered arrangement in order that no two wheels will strike a transverse ridge or inequality (such as an expansion joint), at the same time.

PORTABLE APPARATUS

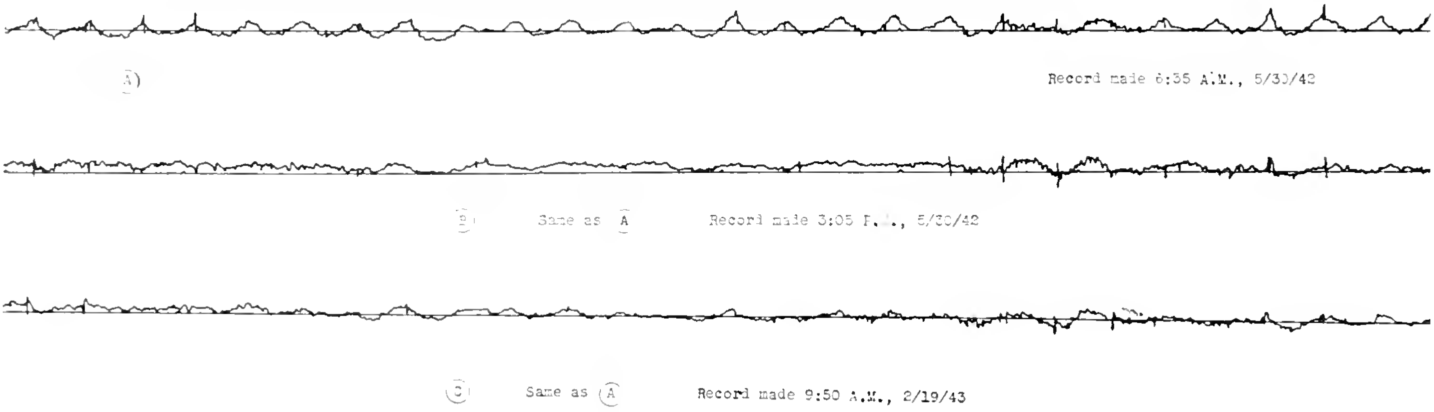
The apparatus may be dismantled into units not over 40″ in length and the entire assembly readily stowed in the trunk and tonneau of a small sedan. The instrument as constructed permits changing of the horizontal scale of the recorded graph to either of the following: 1″ = 50′, 1″ = 25′. The vertical scale may be either 1″ = ½″ or 1″ = 1″. The examples of pavement profiles illustrated herewith were recorded to the scale 1″ horizontal = 25′, 1″ vertical = ½″, and have been reduced to one-half of the original size.

Operation of the profilograph involves the following steps after arriving on the job. First, assembling the

* F. N. Hveem, the writer of this article, is the designer of the new profilograph [illegible] by the Testing and Research [illegible] of the Division of Highways, for [illegible] roughness of highway pavements.



Units of profilograph machine for measuring pavement roughness. 2. Assembling the frame. 3. Close up of recording mechanism
4. Plan view of the machine. 5. Profilograph assembled, ready for use. 6. Profilograph in use



Facsimiles of profilograph records taken on a new pavement under different temperature and weather conditions

machine, second, checking air pressure in the bicycle tire, third, the recording device is installed and pens are filled with ink and adjusted. One pen records the vertical movement of the bicycle wheel with reference to the main carrier frame, the second is adjusted to provide a datum line as a basis for judging the relative deviation of the recorded profile.

TWO PENS USED

The datum pen is actuated by an interrupter which registers a small break in the line at 50 or 100-foot intervals depending on the horizontal scale gear ratio being used. This arrangement of the pens makes it unnecessary for the paper strip to be precisely true or uniform as the two pens will maintain their relative position irrespective of slight lateral movements or shifts on the part of the paper strip.

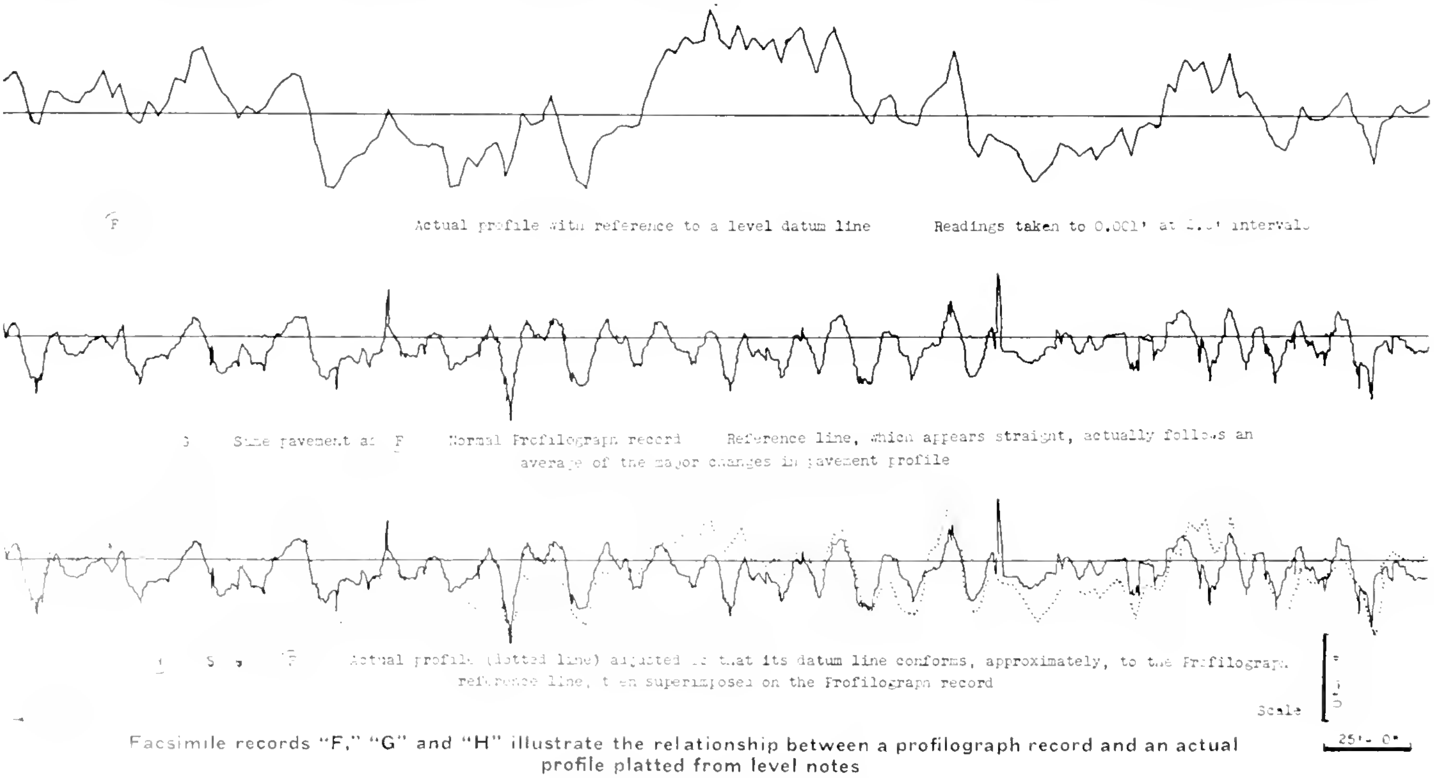
The paper is fed or controlled by two hard rubber rolls and provides a very uniform and dependable horizontal scale without the necessity for special paper having perforations for a sprocket drive. The recording pen is mounted on a small rod supported by flexible bronze reeds. This construction eliminates all sliding bearings which previously gave considerable trouble through the accumulation of dust in the bearings or sliding surfaces which impaired the sensitivity of the recording mechanism.

The instrument can be operated at some three to four miles per hour or as fast as the operator can walk. When being moved from locations separated by only a few miles, it may be readily towed behind an automobile at a speed up to 20 miles per hour.

TEMPERATURE EFFECTS SHOWN

The accompanying photographs illustrate the several steps necessary to assemble the profilograph and the appearance of the unit in operation. The assembling operation will require about 10 minutes and it may be knocked down and loaded into a car in even less time.

To illustrate the type of record produced by the profilograph there are



Facsimile records "F," "G" and "H" illustrate the relationship between a profilograph record and an actual profile platted from level notes shown herewith facsimilies of records which were taken on actual pavements.

Graph "A" represents new pavement; record made in the early morning when the surface of the pavement was colder than the under side in contact with the subgrade.

"B." Same section recorded in the afternoon when the pavement surface temperature was higher than the subgrade temperature.

"C." Same section nine months later taken on a cloudy day in February where pavement temperature and moisture content were very uniform, showing the difference between summer and winter conditions.

INDICATES PAVEMENT CONTOUR

"F," "G," and "H" are included to illustrate the relationship between a profilograph record and an actual profile platted from level notes. The profilograph having an over-all length of some 13′ with a rigid span of only 10′ does not of course, indicate the major undulations in the pavement surface and for the same reason tends to diminish many of the larger irregularities.

A profilograph record should be regarded as evidence of the inequalities which tend to interfere with the smooth travel of the motor vehicle rather than as an exact replica of the pavement profile in space. On a whole, it appears that a profilograph record is an excellent indication of the pavement contour and does not tend to exaggerate the actual roughness other than that which is provided by the scale relationships used.

All of the examples shown were taken in the path followed by the left wheel of the car and the direction of traffic is from right to left.

It seems to be an old rule that before an engineer can be in a position to design improvements of any nature, it is first necessary to measure and evaluate the conditions. The profilograph offers means for providing a reasonably accurate recording of pavement surfaces and should be an aid in solving the difficult problem of designing and constructing pavements which are not only smooth when constructed but which will remain smooth after construction.

Two stenographers were airing their troubles. "I'd like to get a divorce. My husband lives in Ohio and I'm here, and we don't get along."

"Why don't you sue him for incompatibility?" asked the other sympathetically.

"I would if I could catch him at it."

California Snow Pack Below Normal and Water Must Be Conserved

"No water to waste," is the judgment of Edward Hyatt, State Engineer, in appraising the 1944 water prospects for California.

The State Division of Water Resources cooperating with most of the water using organizations of California has just completed an extensive survey of the mountain snow pack in order to determine the amount of water that will come down the rivers of California when the snow pack melts.

Some 150 men traveling on skis visited over 200 locations in the mountains to measure the amount of water stored in the snow pack reaching the length of the Sierras from the Klamath to the Kern.

The snow surveyors found that the snow pack as a whole measured only about 75 per cent of normal; three quarters of its average.

The average snow depth throughout the mountains is four and one-half feet. This is solid and well packed. Measurements in the Coast Range west of Willows show four feet there at the higher elevations. Singularly the greatest depth of snow on the ground measured by the snow surveyors this year was in the mountains of southern California. In Ice House Canyon on the watershed of the Santa Ana River the snow averages 125 inches deep. Second in depth this year is the area that usually runs first; the Lake Helen area in Mt Lassen National Park. The snow there this year averages 115 inches in depth.

In a bulletin issued April 10th the Division of Water Resources listed all snow measurements made throughout the mountains and also published its forecasts of streamflow based upon the snow survey measurements.

Appraising the irrigation situation the Division finds:

"In the Sacramento Valley, with the increased planting of crops for war demands shortages in natural runoff may develop. Economical use will be necessary."

"In the San Joaquin Valley, while there will be no water to waste, there should be sufficient to supply all reasonable demands."

"Present indications are that little or no water will this year flow into Tulare Lake."

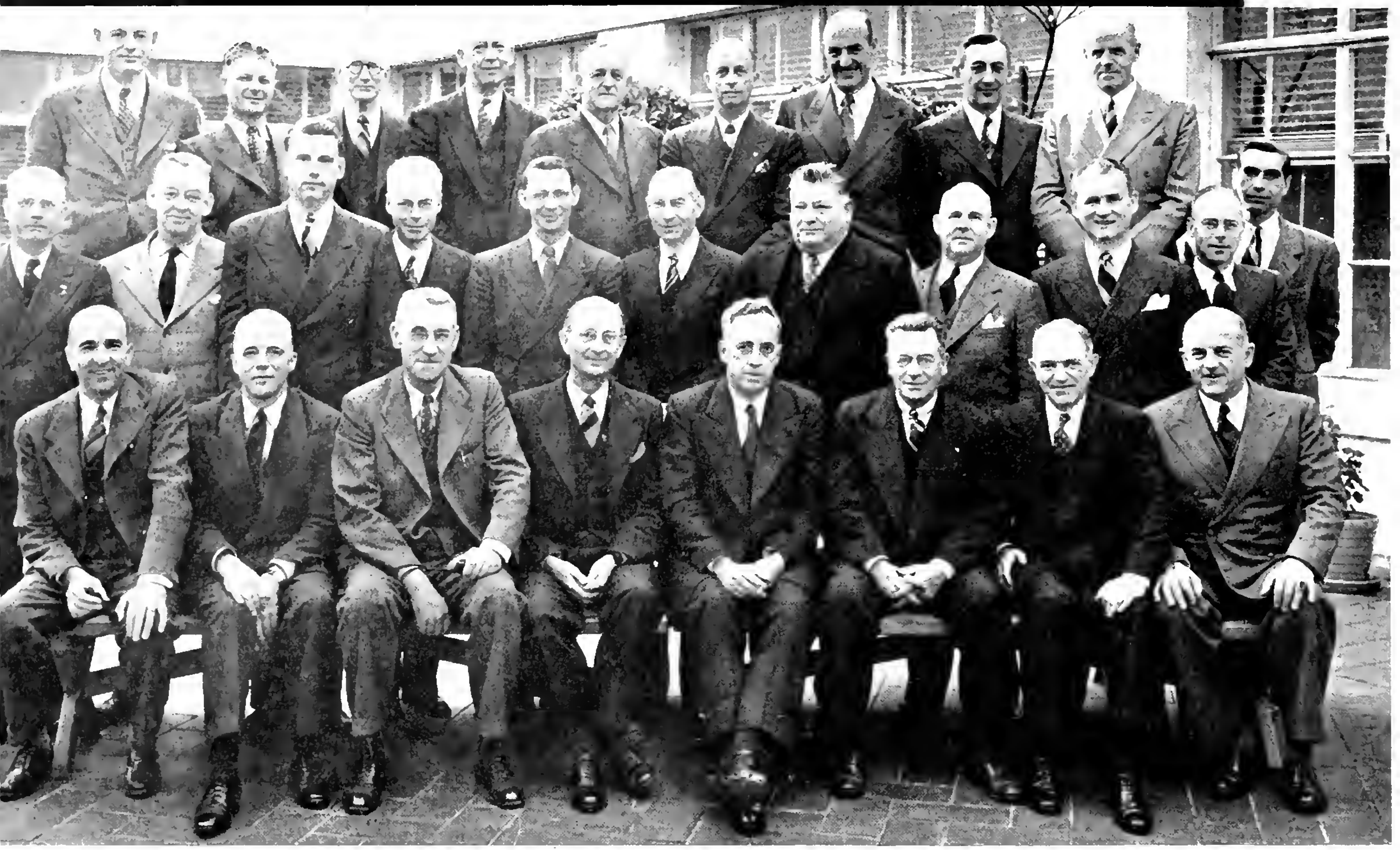
"At Lake Tahoe the snow surveys indicate that the lake surface should rise about a foot above its April 1st elevation; to 6,227.8. This will be 1.3′ below the allowable maximum of 6,229.1 settled upon by agreement between the water users and the property owners around the lake."

The forecasts of run-off of the major rivers of the Sierra during the four months' melting period, April 1st to July 31st, in percentage of the normal run-off for the same period as made by the division were as follows:

	Per cent
Sacramento at Shasta Dam	64
Feather River at Oroville	74
Yuba River at Smartsville	81
American at Fairoaks	76
Mokelumne at Mokelumne Hill	70
Stanislaus below Melones	73
Tuolumne at La Grange	78
Merced River at Exchequer	76
San Joaquin at Friant	78
Kings River at Piedra	[illegible]
Kaweah at Three Rivers	[illegible]
Kern River near Bakersfield	[illegible]
Truckee River at Farad	[illegible]
Rise of Lake Tahoe	[illegible]

Federal Excise Taxes Diverted From Roads

During the 11 years between July 1, 1932, and June 30, 1943, more than $4,200,000,000 was collected in Federal excise taxes levied against the Nation's motorists. During this same 11-year period the total of Federal Aid and emergency funds apportioned to the several States amounted to $2,500,000,000. This shows, therefore, that more than 40 per cent of the Federal taxes collected on gasoline, tires, automobiles, trucks and parts, and the $5 use tax were diverted from road purposes.



At District Right of Way Agents' meeting in Sacramento. Back row (left to right) J. M. Sorenson, Leland Rose, Herman D. Jerrett, J. B. Woodson, L. Ph. Bolander, W. G. Stuntz, Earle Bunker, E. N. Whittemore, Leo J. McCarthy. Middle row, Frank B. Durkee, Lincoln V. Johnson, Joseph F. De Martini, Jack Howard, E. P. Jones, Serge Ray, Brad Perry, George Pingry, George C. Hadley, Robert E. Reed, Holloway Jones. Front row, Ray Pianezzi, E. F. Wagner, G. T. McCoy, Fred Grumm, J. G. Standley, R. H. Wilson, S. W. Elliott, Frank C. Balfour.

Highway District Right of Way Agents Hold Annual Meeting at Sacramento

By FRANK C. BALFOUR, Chief Right of Way Agent

THE annual meeting of the District Right of Way Agents of the 11 districts of the Division of Highways, was held in Sacramento on February 10 and 11, 1944.

The agenda for this year's meeting was the most ambitious in the history of the annual gathering. The topics discussed covered all phases of right of way acquisition and the numerous problems encountered by the right of way agent in his field contacts and negotiations with the property owner.

Ways and means of completing the largest right of way acquisition program in the history of the Right of Way Department to clear the right of way for the huge postwar construction program were discussed at length, and it was the consensus of opinion that there will be no delay in postwar construction because of failure of right of way personnel to carry through their portion of the program to a successful conclusion.

A portion of the meeting was given over to a joint session with the staff of the legal department, at which time Attorneys Frank B. Durkee and Robert E. Reed explained the three recent Supreme Court decisions having a direct and important bearing on freeway and divided highway construction. It was their opinion that the effect of the decisions can not be accurately stated, as they fail to lay down clear general principles that can be applied to different factual situations. In any event, it may be anticipated that the general effect of the decisions will be to make right of way acquisition more difficult not only from the standpoint of increased demands by owners, but also because additional numbers of property owners may have to be contacted.

During the course of the meeting, the new procedure to be followed in right of way acquisition contact work as a result of these decisions, was explained to the gathering.

(Continued on page 17)

The Federal Aid System and the Need for its Improvement

(Continued from page 2[illegible])

one on the system has been in the na-
ure of surface patching and repair
nd in bolstering weakened bridges.

In July, 1943, the American Associa-
ion of State Highway Officials circu-
arized the 48 State Highway Depart-
nents on the minimum amount of
eeded construction on main or princi-
al highways in each State. It should
e stressed that the data submitted in
esponse to these questionnaires in-
luded the *MINIMUM* of needs on the
nain routes, and while these routes are
ot of necessity confined to the Federal
Aid System in the main, they corre-
pond to the Federal Aid routes and
nay be considered to generally repre-
ent the minimum immediate needs of
he Federal Aid System.

MINIMUM NEED TOTALS

Compilation of these estimates show
hat a total of 158,500 miles of high-
vay and 30,000 bridges need rebuild-
ng, widening or relocation and the
otal estimated cost of these immediate
equirements is in excess of 7 billion
lollars.

This total is broken down as follows:

	Miles	Amount
Roads should be rebuilt	74,900	$2,610,000,000
Roads should be widened	46,700	1,190,000,000
Roads should be relocated	36,900	2,420,000,000
Roads, total	158,500	$6,220,000,000
Bridges should be widened or rebuilt	(30,000)	810,000,000
Total		$7,030,000,000

In addition to these estimates of min-
imum necessities, the American Asso-
ciation of State Highway Officials also
has compiled estimates of requirements
for the 48 States to bring the Regular
Federal Aid System, the Federal Aid
Secondary or Feeder System, and the
several urban highway systems to de-
sirable standards for modern traffic.
The estimates of these improvements
needed for adequately handling traffic
on Federal Aid and urban routes total
$11,138,000,000. Broken down be-
tween the three route classifications
this total estimate shows the costs of
needed improvement as follows:

Regular Federal Aid System	$5,315,000,000
Secondary Federal Aid System	3,289,000,000
Urban highway system	2,534,000,000
Total	$11,138,000,000

In the study of the needs of the Nation's Federal Aid highways, certain factors of change must be given proper consideration. Federal assistance to the States and establishment of the Federal Aid System was originally designed as an aid in the development of rural road systems, on the basis of the National interest in good facilities on rural post roads. Similarly, the interest of State highway departments during the earlier years of highway development was entirely concerned with rural roads. City streets were considered the concern of local authorities and their improvement was left in the hands of these local officials.

As motorization of the Nation increased and the roads became filled with cars and trucks it became apparent that responsibility for provision of highway facilities on principal routes through cities could not be saddled entirely upon local agencies. The universality of traffic on these routes necessitated the shifting of responsibility to State Highway Departments. The entire picture changed and proper development of State routes through cities moved up to equal importance with rural road development as a responsibility of the State.

The same change applies to the responsibility of the Federal Government. Rural post roads are no longer the principal criteria. Expansion of interstate traffic on main routes, both rural and urban, has correspondingly enlarged the scope of Federal responsibility. This change already has been increasingly accepted by the Federal Government in Congressional appropriation of funds and in promulgation of rules and regulations by the Public Roads Administration.

FEDERAL AID INADEQUATE

From the foregoing discussion, it is hoped we have established definitely that previous Federal Aid appropriations have been inadequate for the proper development of Federal Aid routes to standards required by modern traffic.

In the light of the facts presented, it is evident that increased Federal appropriations are justified; particularly when consideration is given to the inadequate status of improvement of the Federal Aid System prior to the war, the present increase in the rates of obsolescence and deterioration resulting from the current cessation of construction and reconstruction, and the curtailment of much normal maintenance.

In some sectors the ability of the States to assume postwar programs of large dimensions has been questioned. In support of the contention that the States will be unable to put under way a large National postwar construction program, the critics turn back to the delays in getting highway contracts under way for unemployment relief during the depression of the early thirties. While there is some truth to this claim, such failure on the part of States to quickly let contracts designed to furnish maximum employment was due almost entirely to a lack of preparation of projects located in urban areas where unemployment existed.

In those years the transition of State highway interest from rural to urban areas was just beginning and State Highway Departments had practically no plans prepared for construction in urban areas. Today the picture is entirely different. Every State Highway Department in the Union is now working diligently on the preparation of plans and acquisition of rights of way for projects, balanced between urban and rural areas. By the close of the war each State will have a shelf, well stocked with complete plans for proposed highway construction.

STATES ABLE TO HANDLE

That the States are capable of quickly placing contracts under way is further demonstrated by the success of the current Access Road Program. In our own State of California we have put under way, in addition to the regular work of the department, 142 access road and flight strip projects totaling nearly $30,000,000. Of these projects 114 contracts costing $23,000,000 have been completed and 28 contracts estimated to cost approximately $7,000,000 are still in progress. Other States with comparable military and industrial establishments can produce similar data on access and flight strip construction projects.

Question has also been raised relative to the ability of contractors to take on such a program.

(Continued on page 16)

State Highway Bridge Maintenance Involves Care of 4,633 Structures

By HARVEY D. STOVER, Bridge Maintenance Engineer

MAINTENANCE of California State highway bridges during the war emergency when overloading of structures is often necessary for the movement of heavy equipment is of paramount importance to the Division of Highways. The utmost care is required to keep detailed information based on constant inspections available for instant reference as to the condition and safety factors of each structure.

This extraordinary maintenance control is especially imperative under prevailing conditions that limit repair materials and new construction.

Effort is being made under war conditions to maintain bridges safe for traffic with the minimum of new construction and for this reason, coupled with the difficulty of securing structural materials, bridges scheduled for replacement this season offer unusual maintenance problems.

The Bridge Department of the Division of Highways consists of four sections: Preliminary Investigations, Design, Construction, and Maintenance and Research.

BRIDGES TOTAL 4,633

The Maintenance and Research Section is responsible for the maintenance of all bridges on the State Highway System with the exception of several toll bridges where maintenance is under another section of the Division of Highways. These total 4,633 structures, excluding culverts, distributed throughout the 13,891 miles of State highways; 3,139 built of steel and concrete, 1,380 built of timber and 114 of steel and timber combined.

The activities of the Maintenance and Research Section include:

1. Inspection of State bridges.
2. Inspection of bridges for other agencies.
3. Structural materials records.
4. Control of overloads on bridges.
5. Collecting of statistical data.
6. Railroad crossing records.
7. Research activities.

Inspection of State Bridges

An original inspection report has been prepared for each bridge on the State Highway System and supplemental reports are made annually. In special cases where the structure is failing rapidly, monthly inspections are necessary.

The bridge inspection report records the bridge name, number, location by route and section, and log mile, number and length of spans, type, width clearance diagram, a brief history by whom built, date, designer, etc., condition of stream bed and other pertinent data. Repairs, strengthening or replacement, as required is outlined under the engineer's recommendations. Computations for strength rating are made and filed with the original report and when posting for restricted loading is necessary, the posting limits are included in the engineer's recommendations. The posting procedure will be discussed later.

Inspection of Bridges for Other Agencies

When cities, counties, Division of Forestry, State Department of Natural Resources or other controlling agencies so request, their bridges are inspected and reports are prepared and posting is handled similarly to State highway bridges.

Access road bridges are inspected by agreement with the Public Roads Administration. Striking an average for the past five years, 192 inspection reports on bridges for other agencies have been made annually. The trend of this work is upward.

Control of Overload Permits

In order to allow all districts more leeway in the issuing of overload permits and at the same time to prevent some districts from issuing permits for loads which are too severe on bridges, maps were made of the various highway districts which rated the highways on a basis of bridge capacities, the different capacities being shown by means of colors. Usually highway sections were rated to the strength of the weakest bridge on the section. However, where State highway or important county road junctions occurred between section limits, such sections were subdivided for rating purposes. All highway bridges were rated by the following classifications:

Class 1. Represented the better concrete and steel structures, generally those of H-15 or equivalent design. Such structures were allowed loads 50 per cent in excess of the legal limit under permit.

Class 2. Consisted of the better timber bridges, of which the greatest number are designed for the H-12½ loading, and those concrete and steel structures which were not quite safe for Class 1 loads. These structures were permitted loads 30 per cent in excess of legal.

Class 3. Represented those bridges which, although not posted, were safe for legal loads only by virtue of a reduced safety factor. No loads in excess of the legal limits were permitted on these structures.

Class 4. Represented all structures posted for restricted loading. Districts are not permitted to issue load permits in excess of the posted limit of any such structures.

Maps, charts and sample computations were sent to all highway districts. In order to be able to route loads across district lines, the various highway districts have made copies of their maps and exchanged with the adjacent districts so that at present each district office has maps covering a major portion of the State.

COMPREHENSIVE MAPS

When there is a change in bridge status, such as, posting of structure, replacement of a posted structure, or general progressive deterioration sufficient to effect a change in strength of rating, changes are made on the Bridge Department map and the district in

A typical overload, the largest ever permitted to cross a timber trestle on the State Highway System up to date was a huge transformer for an electric power station. The gross load was 139,950 pounds and the required number of axles on tractor and trailer and the distribution of the weight as figured by the highway engineers is shown in the above picture

volved notified by letter to make a similar change on their map.

The information contained in these maps and charts has been a great help to the districts in issuing overload permits, has placed overloads on a uniform basis throughout the various districts in the State and has resulted in an appreciable reduction of the overloads submitted to the Bridge Department for approval. Another factor which was not anticipated originally is a reduction in a large percentage of loads to fit those allowed by the structure classification. In other words, if an application is submitted for a load in excess of the values given on the chart, the district makes an effort to have the load reduced to chart rating, and is successful in a majority of the cases.

EXCESS LOADS

Loads in excess of those shown which can not be broken down reasonably are submitted, with axle spacings and tire data, to the Bridge Department for future check. Such loads are checked against the actual structures involved. If stresses are not excessive, permits are approved. In a number of cases, the Bridge Department will require redistribution of the load to the various axles or the placing of additional axles under the load before approval is given. As a matter of policy, all loads in excess of those shown on the charts must be weighed, preferably before crossing the structures involved. The certified scale weights of the loads on the various axles are forwarded to the Bridge Department. In some instances we have required that the load be weighed in the presence of a motor vehicle officer and not allowed to continue if the gross or axle loads were in excess of those shown on the permit.

Actually, there is no definite upper limit of gross load which may be allowed under permit provided sufficient axles at adequate spacing can be placed under the load or provided the hauler is willing to place adequate supports under the structures involved at his own expense.

UNUSUAL UNDERTAKING

In the first connection, a load which grossed 228,000 pounds was moved for a short distance over modern concrete bridges. However, the length of load was 151 feet and we required two extra width dual axle dollies each with 16 pneumatic tires between the 3-axle tractor and the 3-axle trailer. The maximum concentration under this vehicle's train was a total of 56,000 pounds on a 10-foot wide, 16-tired 2 axle dolly, which concentration was within the chart limits for the structures involved.

To illustrate the second condition, it recently became necessary to move a load weighing 330,000 pounds over two State highway bridges. The front end of the load was supported on a heavy low bed semitrailer combination consisting of a 3-axle tractor and 2-axle semitrailer having a total of 16 tires on the semitrailer duals. The rear end of the load was supported on a 2-axle 16 tired dolly. Axles were spaced 5 feet and had a width out to out of tires of 13½ feet. Although there were no available scales capable of weighing this concentration, the estimated load was about five times the legal allowable load.

In order to permit this load to cross the Waldo Undercrossing, we required nine 5-post bents, two under each of the 19-foot spans and one under the 13-foot end span as well as additional posts under the caps at midpoint of existing columns. All bents were jacked tightly into place and each post was supported by a 12x12 sill 4 feet in length. Only one bent of similar design was required under the heavier Sausalito Road Undercrossing. We required that a representative of the Bridge Department be present to inspect the supports before the load

Pictures show typical repairs to a timber trestle scheduled for replacement in fall of 1943. Arrows point to rotted stringer and 6- by 8-inch corbels or supports bolted to the sides of the piles. The corbels support 4- by 16-inch stringers used to reinforce the cap

could be moved. With these precautions, this tremendous load was moved without damage to the structures involved.

During the 12-month period July 1, 1942, to June 30, 1943, 8,729 overload permits were issued by the various State highway district offices.

Collecting and Furnishing Statistical Data for Use of State Agencies and the General Public

The maintenance and research section furnishes much statistical information to State and Federal Government agencies, including the military, as well as the general public.

A "Bridge List and Log of State Highways" in book form (8.5 x 11 inches mimeographed) containing some 125 pages, gives an itemized list of all structures on the State Highway System including all grade crossings. This is arranged in order along any given route. One line in the list notes the most pertinent information relative to any one item. Each structure and grade crossing is identified by a "Bridge Number." This number is painted on each structure for identification purposes. With the number is shown the name; location—such as district, county, route and section—log mile; type of structure such as concrete girder, steel truss or timber stringer; number and length of spans; total length of structure and roadway width with sidewalks noted, if any. The vertical clearance is also noted if the structure has an impaired clearance.

The list also shows the city limits of all incorporated cities and towns, junction of all State highways, all section changes and other important features along the route.

It is issued to interested persons and agencies including certain military agencies and the Public Roads Administration. The persons holding these copies are furnished copies of all revisions of this publication.

POSTED BRIDGE LIST

A "Posted Bridge List" shows all structures on the State Highway System which have been posted for less than legal loads, in accordance with the provisions of the Vehicle Code. This list indicates the limits for which the structure is posted and this information is used by all districts in controlling heavy traffic movements and in issuing permits. Many trucking agencies also call for this list which is used by them in routing their loads.

In addition to the "Posted Bridge List" a special map is issued monthly which indicates not only the location of all "Posted Bridges" and the minimum allowable load for each section of State highway, but also shows any other obstructions to the natural flow of traffic. These might be slides, washouts of roads or bridges, or one-way traffic control due to oiling of road or a construction project.

This map is kept up-to-date and issued monthly for use by the State and other agencies, both private and public.

Special reports are made from time to time, to the various military agencies, upon their special request, indicating the capacities of State highways and bridges, for both load and clearance.

RAILROAD CROSSINGS

A field investigation and standard report is made for each grade crossing on the State Highway System. These reports contain all pertinent data as well as a sketch and photographs of the crossing. Supplemental investigations are made at periodic intervals and the reports corrected for changes in protection, trackage, etc. as required.

The section further keeps the accident record of all State highway crossings up-to-date and has available the latest records of highway and railroad traffic. This office is able to furnish trackage, protection, accident and traffic data for all State highway crossings and the major portion of such data for crossings off the Highway System. One function of this section is the furnishing of lists of crossings for additional protection or for separation on a basis of need, particularly when Federal funds become available for such purposes.

Research Activities

The research portion of the work of the maintenance and research section may generally be divided into three classes as listed below, although occasionally, more than one class may be combined in the solution of a particular problem.

1. The collection and compilation of published data and the records of the maintenance and research section and other highway agencies to arrive at conclusions affecting the work of the department.

2. Making physical tests of materials of construction in cooperation

with the Materials and Testing Laboratory.

3. Testing of bridge structures in the field and following up experimental use of new construction materials.

The first method may be illustrated by the following specific projects.

A compilation was made of axle loads and spacings of some 50,000 loaded vehicles of various types from data obtained in the field by the State Highway Planning Survey. One result was the adoption of the standard vehicle types used in the load rating of the existing structures. Another report prepared from this data showed the great discrepancy existing between stresses induced by actual vehicles traveling the highways, as compared to those induced by H-15 design loading, then in use. As a result of the pioneering work done by this department, the State of California is now using a semitrailer design load, and the American Association of State Highway Officials has included a similar loading in their specifications.

CAREFUL INVESTIGATIONS

The development of specifications for rating existing structures was an important project undertaken by this section. These specifications form a basis for computing the capacity of existing structures and, through the efforts of this department, the major provisions of these specifications have been incorporated in the specifications of the A. A. S. H. O.

Quite an exhaustive investigation was made to determine the effects of age in the strength of timber. The engineering index was combed for any published data on this subject and timbers from several old bridges were delivered to the State testing laboratory for strength determination.

An important research undertaken, with the cooperation of the testing laboratory, was the investigation of bridge pins. In these tests, a uniform material, 2-inch steel shafting, was tested in bending under both center and third point loading over a range of span lengths varying from pure shear to a span of 10 diameters. The second part of this investigation consisted in testing actual pins from old structures which had been in service for from 30 to 50 years. As a result of these investigations, the provision that "Bending in pins need not be computed where the lever arm of the couple is less than the diameter of the pin" was incorporated in the rating specifications.

FIELD RESEARCH

Under the third class of research, field investigations utilizing strain gages to determine stresses induced in various structural members under known live loads, have been made on various structures.

The distribution of the wheel loads to the various stringers has been undertaken both for steel and timber structures. Timber structures, both with concrete and laminated decks, on Route 28 in Shasta County were recently tested under known heavy semitrailer loadings operating under permit.

Personnel

There are 11 engineers now employed in the Maintenance and Research Section. The greater portion of these are licensed civil engineers. These men make the field inspections and prepare the bridge reports. When the report recommends day labor work be done, the engineer prepares the plans, bill of materials and estimate of cost. When contract work is recommended, the report is sent to the Bridge Department design section where the plans, estimate and specifications are prepared. When the work is accomplished by day labor, the construction engineering required is assigned to the engineer in the Maintenance and Research Section.

Day Labor Construction Work

Work required in the nature of replacing stringers, redecking, placing supplemental bents, strengthening, pile stubbing, and scour protection, where the extent of the work is more or less indeterminate until the job is underway, is handled by day labor by the Maintenance Department of the Division of Highways. This work is done in most instances during the fall of the year when the district maintenance crews have finished the summer oiling and general highway maintenance. It serves as a ballast in the work to keep the maintenance men busy throughout the season. The availability of these crews throughout the State is of utmost importance for bridge maintenance. In cases of flood damage to bridges or structural failure due to overload, etc., repairs can be started at once. As a result there is minimum delay to traffic when failures occur.

Engineer is examining condition of a timber structure using $\frac{3}{8}$-inch ship auger 18 inches long in a $\frac{1}{4}$ H.P. electric drill and additional special equipment carried in station wagon

The Maintenance and Research Section is assisted in the inspection work to the extent that each District Maintenance Engineer or a qualified assistant inspects all structures at least twice

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The Federal Aid System and the Need for its Improvement

(Continued from page 11)

In California we have examined possible apportionments to the States under the proposed bill, and it was found that $50,000,000 a year would be the maximum which California could expect.

CONTRACTORS CAN DO WORK

During the past two years contractors of our State have entered into and largely completed Federal contracts totaling $300,000,000 for military establishments, air fields, etc. In addition they have undertaken the $30,000,000 in contracts for access roads and flight strips. It certainly would stand to reason that if Pacific Coast contractors could successfully complete these programs, they have the ability to assume an annual highway program based upon a $50,000,000 Federal Aid apportionment.

The availability of equipment and materials for the proposed postwar program has likewise been questioned.

There is no doubt that there is a shortage of equipment. At the present, things are not quite as tight as they were six months ago. However, the resourcefulness exhibited by contractors during the past two years in getting the jobs done with whatever was available, coupled with the expected release of equipment at the close of the war leaves little doubt that the situation will be met as far as equipment is concerned.

Materials shortage is not the problem which some would try to make it.

Even with the routing of steel production into war channels, reinforcing bar steel and some structural shapes are available for necessary work.

NO CEMENT SHORTAGE

There is no cement shortage and while asphaltic products were originally rationed because of feared limited supplies, restrictions on their use were lifted when it was found that, being a residue of manufacture, the supply was not depleted.

A shortage of lumber and timber yes. However, it must be remembered that the entire output of many mills is going into crates and shipping boxes. This diversion from dimension timber will, to a large extent, stop at the close of the war and the mills will be back to normal production by the time highway jobs are under way.

Sand and gravel present no difficulty. Commercial stockpiles are now from two to five times the quantities on hand prior to the war.

During the period of transition of the Nation from the current wartime economy to that of normal peacetime the dislocation of labor and industry will be something unprecedented in our National history. Never before has as great a number or percentage of the people been transferred from civilian pursuits to the armed forces and war industry. Through various official discussions we are informed that approximately one-half the persons employed in manufacture are manufacturing war products. Similar or even higher percentages probably obtain for those employed in services, as all or a major part of most of such services are in connection with the war effort.

Never before has so great a percentage of industry been withdrawn from civilian production to war industry.

TRANSITION CHANGES STAGGERED

As the transition from peace to war has been on an unprecedented scale, so will the postwar transition from war to peace be greater than ever experienced for both industry and those whom industry employs. To meet this latter problem of transition, staggered demobilization and staggered termination of war contracts is anticipated and will be of assistance. The change in public temper at the cessation of hostilities, however, is most likely to make such staggering extremely difficult.

It is generally understood that the period needed for conversion and retooling of industry to peacetime activities will require from six months to two years in the various lines. An additional period of time will be required before industrial production will reach full capacity. In all probability the complete transition to peacetime activity and full employment will consume a period of three to four years during which unemployment will be one of the principal problems of the Nation.

This period of anticipated unemployment will coincide with the period of greatest need for reconstruction and improvement of the Nation's highways.

AUGMENTED HIGHWAY PROGRAM

As previously stated, the anticipated unemployment will be centered in urban areas. The great highway need for arterial and freeway development articulates with employment needs. An augmented highway program during the postwar years of transition will serve in considerable part to alleviate unemployment conditions and to fulfill that function of public works which is designed to keep employment at high levels during depression years.

In conclusion, may I emphasize the principal factors relative to the importance of the Federal Aid Highway System, the need for its improvement and the desirability of other highway development.

While the Federal Aid System consists of 226,000 miles, or only 7.7 per cent of the total National road mileage, it includes the principal State routes and interregional highways and carries 56 per cent of the total motor, truck, and bus travel. Deterioration and obsolescence of the Federal Aid routes and other important highways during the war period of deferred construction, reconstruction and curtailed maintenance will require correction at the earliest possible moment if these arteries of traffic are to serve the great load which they are called upon to carry. The need applies to important routes in and through cities, heavily traveled county roads, State routes and Federal Aid highways.

In this rehabilitation and improvement the responsibility of the Federal Government to interstate and interregional traffic must be given the consideration it deserves.

The proposed Federal appropriations are reasonable in the light of past participation and the present needs of the Federal Aid System, city arterials and important rural county roads.

The States are preparing the plans and acquiring the needed right of way for the task. The contractors have the ability and the desire to undertake the program. Sufficient equipment and materials will be available, and the work will mitigate anticipated unemployment.

Recommendation by the House and Senate Road Committees for the passage of the pending bills is strongly urged.

District Right of Way Agents Hold Annual Meeting at Sacramento

(Continued from page 10)

Holloway Jones, attorney in charge of condemnation trial work for the department, submitted a complete and interesting report on the progress being made in bringing condemnation suits to trial promptly, which during the last two years had proven extremely satisfactory.

The topic of simplifying legal descriptions in documents conveying title or subordinate interests in land to the State, was ably presented by Supervising Right of Way Agent E. F. Wagner.

The question of proper cooperation with county and city officials in handling payment of taxes in connection with acquisition of rights of way, was discussed at length, and a revised policy under which it is hoped to materially improve the present fine spirit of cooperation which exists between the State Highway Right of Way Department and city and county tax collectors, was outlined.

PREPARATION OF APPRAISALS

Supervising Right of Way Agent S. W. Elliott led the discussion on proper preparation of appraisals to determine the market value of land to be acquired and damage to the remaining portion not taken in connection with right of way acquisition.

The present inflationary effect on real estate values and how much consideration should be given to the inflationary trends, received considerable attention, and also the question of consideration of the benefits to accrue to the remaining portion of property not taken, in arriving at a settlement with the property owners.

A number of other important topics having a direct bearing on right of way acquisition and procedure, including further improvement in the maintenance of records of rights of way acquired, were discussed.

ROUND-TABLE DISCUSSION

The last two-hour period of the second day of the meeting was given over to a round-table discussion of the problems the negotiators confront in the field, and ways and means of solving such problems, with special emphasis being placed upon the vital importance of a negotiator fully understanding the proposed highway improvement and the possible effect it will have on abutting property, both beneficial and detrimental. The consensus of opinion was that a successful right of way negotiator must have the ability to sell the improvement to the property owner in a fair and unbiased manner. Otherwise, we can not expect to successfully acquire the necessary right of way.

The District Right of Way Agents in attendance at the meeting, in the order of the highway districts they represent, were as follows:

J. M. Sorenson	District I, Eureka
Leland Rose	District II, Redding
H. D. Jerrett	District III, Marysville
J. B. Woodson	District IV, San Francisco
L. Ph. Bolander	District IV, San Francisco
W. G. Stuntz	District V, San Luis Obispo
Earle R. Bunker	District VI, Fresno
E. N. Whittemore	District VII, Los Angeles
Leo J. McCarthy	District VII, Los Angeles
E. P. Jones	District VIII, San Bernardino
Serge Ray	District IX, Bishop
B. J. Perry	District X, Stockton
Geo. S. Pingry	District XI, San Diego
S. W. Elliott	Supervising Right of Way Agent, Northern Districts—San Francisco
E. F. Wagner	Supervising Right of Way Agent, Southern Districts—Los Angeles
Raymond S. J. Pianezzi	Supervising Right of Way Agent Central Right of Way Office, Sacramento

Representatives of the legal department who attended part of the two-day right of way session, were as follows:

C. R. Montgomery Frank B. Durkee Robert E. Reed	Central Office Sacramento
George C. Hadley	State Building, Los Angeles
Jack Howard Holloway Jones Lincoln B. Johnson J. F. De Martini	Russ Building, San Francisco

It is to be regretted that Mr. C. C. Carleton, Chief of the Legal Department, was absent for the first time in the history of the annual Right of Way Agents' meeting at Sacramento, due to an unfortunate accident in which he fractured a bone in his foot.

The following representatives of the Division of Highways Central Office staff also attended the meeting:

G. T. McCoy	State Highway Engineer
Fred Grumm	Asst. Highway Engineer
J. G. Standley	Principal Asst. Engineer
Richard H. Wilson	Office Engineer
F. W. Panhorst	Bridge Engineer
E. R. Higgins	Comptroller

Life Saved by Aid of Highway Crews

"Big Bear Lake, Calif.
March 21, 1944

Mr. E. Q. Sullivan
State Highway Maintenance Dept.
San Bernardino, California

Dear Mr. Sullivan:

On February 23d we were called for an emergency pneumonia case to be transported to a hospital. The roads were all blocked because of snow and impassable to cars. We phoned your local maintenance camp, but getting no answer, located the crew on the north side of Big Bear Lake and sent them a message that it was imperative for us to get down the hill. In response to our appeal, the foreman sent one plow over the grade and one around the lake, opening the road for us.

Due to the prompt response, we were able to make the trip in time to save the patient's life. We wish to commend the courteous cooperation of the Big Bear Lake crew. It is a great relief to us in the Valley to know that in times of dire need we can count on such splendid support from the State Highway Department.

Appreciatively yours

LARRY BOYLE, Driver
Mountain Ambulance Service"

Little Tommy had spent his first day at school. Mother was anxious to know how he had got on.

"What did you learn, dear?" she asked.

"Didn't learn nothin'," come the reply.

"Well, then, what did you do?"

"Didn't do nothin'. A woman wanted to know how to spell 'dog,' and I told her. That's all."

Major Highways Blocked by Snows

(Continued from page 5)

TRUCK COMPLETELY BURIED

Two of the Greyhound buses followed a rotary plow east, but one broke down due to engine trouble after traveling one mile. The other bus traveled only to the Yuba Gap Maintenance Station. By 11 a.m. a one-way road was opened from Yuba Gap to the airport and all bus passengers were removed and taken to Colfax. Private cars and transport trucks were later dug out and sent west. In this same area a state-owned light truck abandoned near the airport was entirely buried by snow in about two hours.

The official records of the United States Weather Bureau indicate wind velocities during this particular storm at Donner Summit and Blue Canyon between 25 and 46 miles per hour on March 3d, and 22 to 18 miles on March 4th. The snow pack at Donner Summit was 123 inches prior to the storm and 138 inches at 7.30 a.m. March 5th.

After five short closures of U. S. Highway 99 over the Ridge Route, a severe storm of four days' duration closed this important highway from 7.30 p.m. on February 19th to 12.30 p.m. on February 23d. The snow fell between Newhall and the north end of the Grapevine, although the heaviest snowfall was near the Summit and covered approximately 25 miles of highway. During this time, 58 inches of snow was measured at Gorman.

DISTANT EQUIPMENT SECURED

In order to open the road, all available snow removal equipment was moved from the Angeles Crest Highway which was allowed to close in order to speed up the work on U. S. 99. A total of nine push or grader plows and two rotary plows were in continuous use throughout the storm.

As soon as the snow was removed from the pavement of U. S. 99 during this four day closure, the cold weather which accompanied the storm caused ice to form on the pavement. This ice cake, varying from 1 to 4 inches in thickness, could not be removed by snow plows and made driving hazardous. During this time, when snow plow operations permitted, a few convoys of trucks and passenger cars with chains were escorted through behind snow plows or sanding trucks.

In the Los Angeles area where snow is a rarity, only a few motorists, those who frequent snow sport areas, have skid chains. It therefore became necessary to close the highway for the safety of traffic. In other localities, cars properly equipped are allowed to travel under similar snow conditions.

The importance of carrying skid chains when driving into snow areas can not be too strongly emphasized. Without chains motorists endanger their lives as well as others when there is snow or ice on the pavement.

The Department has endeavored to give the best possible service on the major transcontinental routes. We recognize the hardship that may have been felt by people living in resort areas who had become accustomed to prompt snow removal and by others whose roadside business was of necessity affected by the road closures. However, the war has made it necessary to do without many things. As we have not been able to purchase new equipment, it was felt necessary to conserve that on hand. Our efforts were therefore concentrated on strategic highways.

Governor Sets Precedent in Naming New Toll Bridge Authority Member

FOR the first time since it was created, the California Toll Bridge Authority has as a member a citizen who is neither an elective nor appointive State official.

Appointed by Governor Earl Warren on April 4th, Ernest L. Adams, prominent Chico business man, assumed the duties of his office at a meeting of the Authority on April 6th.

Under the law establishing the Authority, it was provided that the members of that important State agency shall consist of the Governor, Chairman; the Lieutenant Governor, Director of Public Works, Director of Finance, and Chairman of the California Highway Commission. When the 1943 Legislature combined the positions of Director of Public Works and Chairman of the Highway Commission, and Charles H. Purcell as Director of the Department of Public Works became also the head of the Highway Commission, there existed in the opinion of the Attorney General a vacancy on the Authority which the Governor was empowered to fill by the appointment of a private citizen.

RICE CROP EXPERT

Mr. Adams, a native of Kansas, following his graduation from the Kansas State College, entered the service of the United States Department of Agriculture and was in charge of the Division of Wheat and Barley in Montana and the Northwest until 1912, when he was sent to California to help develop the rice industry.

He established a federal rice experimental station at Biggs in Butte

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A powerful rotary plow hurls snow high over the Donner road to the opposite bank

Old Railroad Span Refabricated to Provide a New Highway Bridge

By CHARLES R. POPPE, Associate Bridge Engineer

AN excellent example of the manner in which the Division of Highways was able to replace one storm damaged bridge while using a minimum amount of critical material was provided by the bridge across Oak Run Creek in Shasta County, about 12 miles east of Redding on State sign route 44.

The original timber bridge on concrete abutments across Oak Run Creek was built by the county in 1912. It consisted of four spans of approximately 20 feet each and provided a roadway width of 18 feet, 6 inches.

During the winter of 1942-43, the central bent or support of the structure was washed away. A temporary support was installed in order to permit the use of the bridge until such time as a new one could be constructed.

Old four-span timber bridge across Oak Run Creek that had to be replaced

BOUGHT OLD RAILROAD SPAN

Previously, when it had become almost impossible to obtain critical materials for bridge construction on nondefense highways, the Division of Highways had been able to purchase a complete, through plate girder railroad bridge of 82 feet, 8 inches span. This bridge had originally been built by the American Bridge Company in 1919 for the Bay Point and Clayton Railroad at its crossing over the Santa Fe Railroad near Port Chicago, Contra Costa County.

Single span steel railroad bridge State was able to buy for replacement

The bridge was purchased by the State primarily for the girders inasmuch as the floor beams were too short for reuse as such on a highway structure. Consequently, when the bridge was dismantled, the floor beams were carefully cut off with a torch at a distance of 3 feet 11 inches out from the girders leaving the entire floor beam brackets in place on the girders.

When it became necessary to replace the bridge at Oak Run Creek, it was found possible to alter the old steel railroad bridge to such an extent that it could be used at that location. A careful study of the alteration problem indicated that by welding approximately 12 inches of plate on each floor beam bracket, it would be possible to splice the railroad stringers to the brackets, thereby making floor beams upon which a concrete deck providing an 18-foot roadway width could be placed.

Also in order to accommodate the girders, it would be necessary to provide girder seats on the existing concrete abutments at Oak Run Creek and to permit the clearance required for high water, the highway grade must be raised about 2.7 feet.

OLD RIVET HOLES USED

Plans were prepared on this basis and also provided for the railroad bridge floor beams to be cut up to furnish much of the needed splice material. Wherever it was possible to do so, existing rivet holes in the splice material were used in order to reduce the refabrication costs to a minimum.

It is interesting to note that of the 134,060 pounds of structural steel in

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Cosumnes River Bridge Truss Replaced Without Interruption of Traffic

IN line with the Division of Highway policy of keeping traffic flowing with the least possible use of new and strategic materials another bridge has been reconditioned to provide safe travel for the duration.

An inspection revealed that the contion of the structure made imperative the installation of a new truss. The deck, or floor system, was accordingly supported on falsework while the old truss was removed and a new truss built around the deck while traffic continued to use the bridge.

This bridge spans the Cosumnes River on State Route No. 65 between Plymouth and El Dorado and consists of a 120-foot through timber truss span with timber trestle approaches at each end, making a total length of bridge of 271 feet. Periodic inspection had made it increasingly apparent that major repairs would have to be made immediately if traffic, important to the war effort, was to be maintained with safety.

With falsework supporting deck and a traveling gantry new truss is being installed

SERIOUS EFFECTS OF DECAY

Although minor repairs had been made, decay in the truss joints and floor beams had progressed to a point where serious deflection had taken place. The approach trestle and the floor system of the truss were found to be in fair condition.

Since most of the truss members were decayed beyond repair it became necessary either to erect a new truss or place bents under the floor system of the old truss thus making a trestle of it. The latter solution was discarded, however, in view of the high water which prevails at the site during peak run-off.

Completed job with new truss in place and falsework removed

NEW TRUSSES DESIGNED

Having determined that a new truss was necessary the problem of availability of material arose, since timber had become as difficult to obtain as many other more durable building materials. After some inquiry a local mill was found that could produce the timber necessary for truss construction but could not handle pieces of greater length than 22 feet nor could they furnish new 20 by 26-inch timber floor beams. Further search located some State owned steel "I" beams in a maintenance yard which could be used for floor beams. With these materials and the steel rods, castings, and hardware of the old bridge, new trusses were designed and built.

The new truss members are made up of three laminated timbers 6 by 14 inch with splices staggered along the chord members. The proper distribution of stress was obtained by the use of split-ring timber connectors, thereby making use of the available short timbers.

STEEL SPLICE PLATES USED

Steel splice plates from the old truss splices were also used in the new splices. The steel floor beams were hung from the steel hanger rods salvaged from the old truss. These rods had to be turned 90 degrees to their former position to straddle the floor beams at each end and a connecting plate formed a seat for these beams. The floor beams were cut and fabricated at a shop before shipment to the site.

TRAFFIC UNINTERRUPTED

To provide for uninterrupted traffic during the dismantling of the old truss and erection of the new, the deck of the truss span was supported on temporary bents located on both sides of each floor beam. These bents were extended each side of the trusses to support a track for the legs of a gantry traveler which the contractor used for dismantling and erecting. The new trusses were framed and assembled for fit on a large platform in a yard at Lone, adjusted as necessary, then taken apart and hauled to the site for erection.

The advertising of the contract was so timed that all work could be completed before danger of high water. The resulting structure is compact and sturdy and should give a number of years of satisfactory service.

Governor Sets Precedent In Naming Toll Bridge Authority Member

(Continued from page 1)

County and supervised its operation for a period of five years, when he resigned to enter the rice growing business for himself. On July 1, 1924, he was elected president of the Rice Growers Association of California and has served continuously in that position until the present time. He is the owner of a 5,000-acre ranch in the Chico area, which he personally operates for diversified farm purposes. He is also a member of the California Almond Growers Exchange.

REPRESENTS PRODUCE SHIPPERS

The appointment by Governor Warren of Mr. Adams gives to the great Sacramento Valley and the truck shippers of produce of California who are users of the State's three publicly-owned toll bridges—the San Francisco-Oakland Bay Bridge and the Carquinez and Antioch bridges—all of which are under the jurisdiction of the Toll Bridge Authority, their first representation on the Authority.

Mr. Adams brings to the Toll Bridge Authority many years of experience in the farming, agricultural and livestock shipping and transportation field.

Water Storage Behind Shasta Dam Exceeds Million Acre-Feet

IN view of the current dry year and the consequent necessity for conserving water this season, State Engineer Edward Hyatt is encouraged by the announcement of the United States Bureau of Reclamation that at 5 a.m. on April 15th the water storage of Shasta Dam reservoir had attained the 1,000,000 acre-feet mark. The reservoir has a capacity of 4,500,000 acre-feet.

Water has been backed up behind the dam for some 30 miles. The water depth at the face of the dam is 325 feet.

Trucking Industry Calls Attention to Highway Problems

In large display advertisements appearing in many newspapers throughout the Nation during April, the American Trucking Industry calls attention to problems which confront the California Division of Highways as well as other State Highway Departments due to wartime restrictions on highway construction and maintenance and on the purchase of equipment and equipment parts.

Calling attention to the percentages of food products hauled by the trucking industry, such as 100 per cent of the milk for 34 large cities and big percentages of meat, poultry, butter and vegetables, the advertisement says:

"To keep food and war materials moving swiftly, highway transportation must be given sufficient new equipment quickly. Highway bottlenecks must be completely erased. Roads must be regularly and properly maintained. Roads that are inadequately maintained, slow and endanger irreplaceable equipment. Let's supply our Highway Commissions with the tools, engineers, materials and men they need, now."

"It will be our purpose," said Assistant Regional Director Robert S. Calland of the Bureau of Reclamation, "so to regulate releases from Shasta Dam that irrigators will be able to get their full entitlements. In this connection we are asking the irrigators to cooperate not only in giving us advance notice of their needs for additional water, but also when they expect to reduce their diversions, so that we can meet the requirements without wasting water.

ELIMINATES SALINITY MENACE

"The stored water behind Shasta Dam will be a highly valuable asset during the late summer months and it will be to every irrigationist's advantage to cooperate with a difficult situation in this dry year."

In the wealth of water already in storage at Shasta Dam, State Engineer Hyatt sees a factor that may be of prime importance in salinity control in the delta area of the lower Sacramento River and the San Joaquin River this summer.

"Should conditions in the Contra Costa canal, valuable unit of the Central Valley Project, threaten to become salty this season due to lack of water," Hyatt said, "the storage volume at Shasta will make it possible to eliminate such a threat. The Contra Costa canal already is serving irrigationists and it would be serious if we were unable to control salinity problems that might arise there. Hence, the water already stored at Shasta is an encouragement to Contra Costa irrigators. Irrigationists in the delta region also, it would appear, will have no cause for alarm although it will be imperative that no water be wasted this year."

Calland pointed out that Shasta Dam already is serving the multiple purposes for which it was designed.

PREVEN[illegible] MENACE

While this year was not marked by heavy precipitation in the Sacramento Valley the Shasta Dam on one occasion operated to prevent an overflow of water into the lowlands along the Sacramento River.

Early in February the river crested at 11.3 feet in Red Bluff. To an i[illegible]

Report on Progress and Records in Pavement Construction During 1942-43

By EARL WITHYCOMBE, Assistant Construction Engineer

THE demands of the war effort on the trained personnel of both the contractor and the State, and the scarcity of construction equipment resulted in a decreased rate of production and some sacrifice in the quality of the work completed in 1942 and 1943 as compared to that of previous years.

Despite conscientious efforts on the part of contractors to speed the work as much as possible to meet the tempo demanded in time of war, the lack of crews trained in teamwork retarded progress materially.

In the work of paving, it is nearly axiomatic that speed of production and quality of work go hand in hand. The high degree of efficiency necessary to excel in output contributes to the improvement in quality of the finished product.

However, the records of the work completed in 1942 and 1943 reflect these conditions when compared to past records, but not to an alarming degree. The results obtained by the contractors' organizations and the State forces working under such adverse circumstances reflect much credit to both.

CEMENT-TREATED BASE

About 53.3 miles of cement treated base were constructed in 1942, and 9.1 miles in 1943, of which 6.0 miles were under asphalt concrete pavement, and 56.4 miles under plant mixed surfacing. These cement treated projects were all plant mixed excepting one 2.4 mile job in San Joaquin County, which was road mixed.

Test results indicate these base courses are of excellent quality. Some breaks are nearly as high on the very lean and dry mixture as those of concrete paving projects. No attempt has been made to com[illegible] compare these mixtures on [illegible] basis due to the obvious [illegible] strengths, depending upon the nature of the aggregate provided for the individual projects. With a given aggregate, a resident engineer can obtain no greater strength from his mixtures than that inherently in the aggregate itself, and it would be manifestly unfair to compare all the projects on such a basis.

PORTLAND CEMENT CONCRETE

The use of redwood plank as expansion joint material has become universal in practice. A more positive expansion joint has resulted due to the rigidity of the material which aids greatly in placing and maintaining in the designed position. The standard joint interval now is $\frac{3}{4}$-inch expansion joint at 120-foot intervals, with weakened plane intermediate joints at 15-foot intervals.

During 1942, all steel was eliminated from the standard design for concrete pavement, including the dowel steel for load transfer at transverse joints. As a substitute for the load transfer design, the slab end at expansion joints on the side of approaching traffic is thickened in the last two feet of length, from the thin center to the uniform thickness of the edge.

On the departing side, the uniform thickness of the edge is carried a distance of $5\frac{1}{2}$ feet from the joint and then tapered in 2 feet to the thin center section, with a weakened plane joint in the center of this 15 foot panel. No change in design was made at weakened plane joints when dowel transfer was removed, in the belief that aggregate interlock affords sufficient transfer.

The use of larger pavers is receiving considerable attention and during the past two years the 34E paver made its appearance on some of the projects. With the permissible 20 per cent overload now provided for in our specifications, these pavers can mix $1\frac{1}{2}$ cubic yards of concrete.

ASPHALT CONCRETE

Bituminous finishers of the type that operate without side forms were used to a much greater extent during 1942 and 1943 than ever before. Side forms, however, were used in much of this work, and the finishers were operated on them by means of outrigger wheels riding on these side forms. It is not possible to lay in widths greater than one lane with these machines. Asphalt concrete was used to a much greater extent for thin resurfacing in the past two years than ever before. This has been largely brought about by the perfection of the above machines.

Riding qualities in general are not as good on work performed by the machines that lay their own grade as that obtained with the conventional self-propelled spreading, raking, and finishing machines operating from side forms. The cost of doing the work is not comparable between the two methods. For these reasons the two methods are never permitted to be optional and the exact method to be used is specifically designated in the special provisions for the individual project.

BITUMINOUS TREATED SURFACES

Plant mix was used on 87 per cent of the bituminous treated mileage laid in 1942 and 73 per cent in 1943. The greater part of this mileage was laid with spreading machines. Some of the best-riding surfaces and some of the poorest are included in the work done by machines.

The outstanding work of spreading with motor graders are the three plant-mix projects in District VIII. On the two projects, Contract 48XC3, Dracaea Avenue to Rte. 19; and Contract 48XC1, 3 miles south of March Field to Dracaea Avenue, the binder was 150 to 200 penetration asphalt, and on Contract 48VC2, Cherry Avenue to

San Bernardino, the binder was SC-6 liquid asphalt.

A special technique had to be worked out to successfully lay this hard asphalt with blades. The riding qualities of the finished pavement are surprisingly good for the type of mixture used.

An exceptionally good riding surface was secured on the one armor coat project constructed during 1942, Contract 1IWCo, Watsonville to Rob Roy Station. Such work is ordinarily considerably rougher than other types of pavement.

Following is the tabulation of the records achieved in the various types of pavement construction during the years 1942 and 1943. With the return of more normal working conditions, it is believed that the excellent records made on State highway projects during preceding years will again be approached if not surpassed.

PORTLAND CEMENT CONCRETE PAVEMENT RECORDS FOR 1942

Location	Contractor	Resident Engineer	Street Assistant	Average cu. yds. laid per day	Average strength 28 days, lbs. per sq. inch	Roughness index, inches per mile
Bass Hill—Crespos	A. Teichert & Son	M. Fredericksen	A. Bigelow	223.7	3049	6.4
2.5 mis. E. of Yolo Causeway—Washington Underpass	A. Teichert & Son	J. W. Corvin	W. J. Braker	285.0	2981	8.5
Ben Ali—McClelland Field	J. R. Reeves	W. G. Remington	W. J. Braker	383.3	3642	10.6
Powell St.—Panhandle Blvd.	Lee J. Immel	H. A. Simard	G. W. Levier	150.4	3910	12.5
San Luis Obispo—0.8 mi. W. of Pennington Crk.	H. W. Polk	H. J. Doggart	S. N. Isham	354.1	4010	9.2
Ft. Tejon—1.4 mis. N. of Grapevine Sta.	Griffith Co.	F. W. Howard	L. Tresidder	400.0	2510	8.3
At Beetox, over Beardsley Canal	Vido Kovacevich	E. L. Seitz	F. Noel	115.5	4205	5.2
Long Beach Traffic Circle—Carson St.	J. E. Haddock	C. N. Ainley	R. Palmer	456.0	3273	
N. Figueroa St., Ave. 22—Adobe St.	WPA	C. P. Montgomery	W. T. Lamb	211.0	4275	11.0
Rosemead Blvd., Las Tunas Dr.—Longden Ave.	J. E. Haddock	C. P. Montgomery	H. D. Johnson	384.1	5105	12.9
Centinela Ave.—Slauson Ave.	Griffith Co.	C. N. Ainley	P. M. Hine	379.8	4392	13.3
Riverside—Route 78	J. E. Haddock	G. E. Malkson	B. Nelson	543.0	3105	8.2
Carson St.—Center St.	Sully-Miller Contr. Co.	W. D. Eaton	C. C. French	241.7	3900	12.9
Jct. Rte. 74 near Flosden—Walnut St.	Heafey-Moore Co.	G. R. Hubbard	F. L. Lucas	408.4	4450	13.3
1.3 mis. N. of Dixon—S. Fork Putah Crk.	N. M. Ball Sons	R. H. Lapp	F. L. Lucas	692.7	3790	5.1
Pacific Highway, Market St.—Couts St.	V. R. Dennis Co.	F. D. Pearce	M. C. Barron	171.6	2750	...
Pacific Highway, Enterprise St.—Mission Bay	Griffith Co.	W. T. Rhodes	S. M. Templeton	253.0	2112	...
			Averages	367.3	3690	8.0

PORTLAND CEMENT CONCRETE PAVEMENT RECORDS FOR 1943

Location	Contractor	Resident Engineer	Street Assistant	Average cu. yds. laid per day	Average strength 28 days, lbs. per sq. inch	Roughness index, inches per mile
East end of S. F.-Oak. Bay Brg.—Toll Plaza	Lee J. Immel	W. A. Rice	L. G. Marshall	201.0	3829	12.8
½ mi. W. of Orinda Jct.—1½ mis. W. of LaFayette	Chas. L. Harney	G. L. Beckwith	D. M. Young	426.7	4306	10.6
Distribution structure, University Ave.	Lee J. Immel	F. W. Montell	H. Ray	132.1	3888	21.9
22nd St. Peralta St.—Wood St.	Louis Angelus Co.	H. A. Simard	C. Hendrickson	136.0	4516	22.7
Salinas—½ mi. North of Santa Rita	Granite Construction Co.	F. R. Pracht	S. Isham	559.8	4744	11.8
0.7 mi. N. of Monterey Ave., Marina—Castroville	Granite Construction Co.	J. C. Adams	M. Dawson	506.9	4219	10.6
0.7 mi. N. of Monterey Ave., Marina—Reservation Bdy.	W. J. Wilkinson & H. B. Scott	J. C. Adams	M. Dawson	528.2	3704	15.0
Snow Road—2.5 mis. S. of Shafter Rd.	Union Paving Co.	F. W. Howard	C. C. Hinsdale	557.8	3199	12.5
On Fries Ave. LaPaloma Ave. & Falcon St., Anacapa St.—San Clemente Ave.	Griffith Company	W. D. Eaton	Z. Holzman	310.2	4121	16.3
Macy Street—Indiana Street	J. E. Haddock	G. H. Lamb	H. Noble	207.2	4140	14.4
On Harbor Drive N., Civic Center—Rosecrans St.	Ralph A. Bell	H. F. Caton	C. R. Hagberg	523.0	3007	13.3
Rosecrans St., Mission Valley Rd., Lytton St. Sixth St. Ext.	R. E. Hazzard & Sons	J. F. Jorgensen	S. M. Templeton	299.0	3185	11.0
8th St.—Harbor Dr. S. Roosevelt St., National City, G St., San Diego	V. R. Dennis Const. Co.	R. C. Payne	E. C. Daniels	295.7	3252	13.1
Torrey Pines—Del Mar	Oswald Bros.	W. T. Rhodes	C. L. Harkins	229.6	2861	24.7
			Averages	337.0	3588	14.2

ASPHALT CONCRETE PAVEMENT RECORDS FOR 1942

Location	Contractor	Resident Engineer	Street Assistant	Average tons laid per day	Average stability of surf. mix in %	Roughness index, inches per mile
Watsonville—San Andreas Road	Granite Rock Co.	A. Walsh	W. Samarzich	348.0	39.6	13.7
On 14th and 15th Sts., Richmond	Heafey-Moore Co.	L. G. Marshall	H. Deardorf	210.0	30.1	28.2
El Cerrito Hill Overhead, Albany—Richmond	Piazza & Huntley	F. W. Montell	H. L. Joynes	722.3	32.8	16.3
Powell St.—Panhandle Blvd.	Lee J. Immel	H. A. Simard	G. W. Levier	208.1	36.2	39.2
Southern Pacific R. R.—Levee Canal	Griffith Co.	D. G. Evans	L. Tresidder	503.5	45.4	34.4
Southern Pacific R. R. crossing Levee Canal	Griffith Co.	D. G. Evans	W. M. Nett	522.1	45.0	28.9
Carson St.—Center St.	Sully-Miller Contr. Co.	W. D. Eaton	R. E. Schott	365.2	41.8	19.3
At Long Beach Traffic Circle	Vido Kovacevich	C. L. Gildersleeve	E. C. Daniel	278.2	37.7	27.2
Through Hermosa Beach, on Sepulveda Blvd.	Griffith Co.	C. N. Ainley	V. K. Tarwater	452.7	41.7	11.3
Lincoln Ave.—Orangethorpe Ave.	Oswald Bros.	C. L. Gildersleeve	C. J. McCullough	628.2	39.5	19.5
Long Beach Traffic Circle—Carson St.	J. E. Haddock	C. N. Ainley, W. D. Eaton	H. Lindley	627.4	31.3	18.6
Croft Ave.—Fairfax Ave.	Frank West	C. N. Ainley	P. M. Hine	369.6	45.0	33.5
Long Beach Traffic Circle—Carson St. and Lakewood Blvd.	Vido Kovacevich	Z. Holzman	R. Palmer	450.5	44.0	23.7
Redlands—3 mis. east	Oswald Bros.	R. A. Bergman	W. Ford	401.8	41.3	17.1
Pacific Highway, Market St.—Couts St.	V. R. Dennis Co.	F. D. Pearce	M. C. Barron	400.4	37.9	15.2
Pacific Highway, Enterprise St.—Mission Bay	Griffith Co.	W. T. Rhodes	M. C. Barron	529.0	42.6	21.5
Barnett Ave. and Lytton St., Rosecrans St.—Pacific Highway	R. E. Hazard & Sons	F. D. Pearce	S. M. Templeton	377.0	47.2	15.7
			Averages	452.0	38.7	19.3

ASPHALT CONCRETE PAVEMENT RECORDS FOR 1943

Location	Contractor	Resident Engineer	Street Assistant	Average tons laid per day	Average stability of surf. mix in %	Roughness index, inches per mile
Cutting Blvd., Richmond, Garrard Blvd.—14th St.	Lee J. Immel	H. C. Farris	E. Carlstad	478.9	45.8	17.4
N. City Limits, Richmond—Carquinez Brg. (por.)	A. J. Raisch	A. Walsh	A. W. Steward	638.1	41.8	16.0
Dublin—Castro Hill	Louis Biasotti & Son	E. A. Bannister	W. Gillespie	146.8	44.8	16.3
Bay Brg. Toll Plaza—Distribution Structure	Lee J. Immel	L. G. Marshall	L. G. Marshall	453.9	---	17.1
3d St., Custer Ave.—23d St., Mariposa Ave.—4th St.	Chas. L. Harney	H. A. Simard	G. W. Levier	537.9	44.5	12.9
Atlantic Ave., Main St.—Webster St.	Heafey-Moore Co.	L. G. Marshall	L. G. Marshall	360.5	---	11.4
Charter St., Redwood City—San Francisquito Crk. Brg.	Union Paving Co.	G. A. Wildman	E. W. Herlinger	836.7	42.0	12.7
Distribution Structure—University Ave.	Lee J. Immel	F. W. Montell	J. R. Brummer	472.4	45.7	26.2
Orinda Junction—1¾ mis. W. of LaFayette	Chas. L. Harney	G. L. Beckwith	H. Ray	528.0	41.0	16.8
Snow Rd.—2.5 mis. S. of Shafter Rd. (por.)	Union Paving Co.	F. W. Howard	C. C. Hinsdale	452.7	40.7	31.4
Macy Street—Indiana Street	J. E. Haddock	G. H. Lamb	W. C. Winkler	480.0	42.0	17.8
Imperial Highway, Anza Ave.—Sepulveda Blvd.	J. E. Haddock	C. N. Ainley	W. D. de Camp	527.5	44.2	17.7
At Rindler Creek	Louis Biasotti & Son	G. R. Hubbard	R. J. Clarke	337.5	---	40.2
On Harbor Drive North, Civic Center—Rosecrans St.	Ralph A. Bell	H. F. Caton	M. C. Barron	357.2	47.7	29.0
8th St. & Harbor Drive South (por.)	V. R. Dennis Const. Co.	R. C. Payne	C. B. Mackey	327.3	46.0	25.3
Torrey Pines—Del Mar	Oswald Bros.	W. T. Rhodes	W. Ford	324.7	45.7	29.1
Rosecrans St., Mission Valley Rd., Lytton St. 6th St. Ext.	R. E. Hazard & Sons	J. F. Jorgenson	S. M. Templeton	300.7	33.0	28.8
			Averages	489.0	43.1	17.4

BITUMINOUS TREATED SURFACES—1942

PLANT MIX

Location	Contractor	Resident Engineer	Roughness Index Inches per Mile
At Rohnerville Curve and Fernbridge	Mercer-Fraser Co.	J. E. Dessinger	36.4
Loleta—Salmon Creek	Mercer-Fraser Co.	J. E. Dessinger	30.8
Bass Hill—Crespos	A. Teichert & Son	M. Fredericksen	7.4
Keddie—Quincy	Harms Bros.	R. R. Norton	48.0
Quincy—Western Pacific Subway	Harms Bros.	R. R. Norton	27.4
Roseville—0.6 mile east	Poulos & McEwen	E. L. Miller	13.9
Mills—Mather Field	A. Teichert & Son	E. Hay	18.6
Morrison Crossing—Camp Beale	Hemstreet & Bell	A. S. Hart	13.7
Linda Corners—Camp Beale	Hemstreet & Bell	J. W. Corvin	15.4
Sacramento City Limits—Auburn Blvd.	A. Teichert & Son	E. Hay	14.3
Beach Road—San Andreas School	WPA-Granite Const. Co.	C. T. Ledden	9.9
Intersection Routes 1 and 52 Alto.	J. J. Ongaro	W. A. Rice	35.6
Jct. Rte. 14—west of Christie Underpass	Lee J. Immel	L. G. Marshall	24.5
East Reservation Bdy.—Jolon	WPA-N. M. Ball Sons	V. E. Pearson	8.5
North Reservation Bdy.—Jolon	WPA-N. M. Ball Sons	V. E. Pearson	7.6
Rt. 2 near Bradley—Hames Valley School	L. Biasotti & Son	V. E. Pearson	8.9
North Reservation Bdy.—Quinado Canyon	Brown, Doko & Baun	F. R. Pracht	21.3
East Reservation Bdy.—Hames Valley School	N. M. Ball Sons	V. E. Pearson	9.0
Quinado Canyon—King City	Basich Bros.	F. R. Pracht	6.7
Castroville—Rte. 2 near Prunedale	Harms Bros.	F. C. Weigel	12.6
Santa Margarita—Northerly Boundary	A. J. Raisch	A. L. Lamb	11.9
Various locations on Rts. 2, 56, 149	L. A. Brisco	D. J. Faulkner	17.6
0.6 mi. W. of Bakersfield—Bakersfield	George von Kleinsmid	D. G. Evans	32.1
S. Chester Ave. 4.5 mi. S. of Bakersfield	George von Kleinsmid	C. C. Hinsdale	50.8
Stewart St., Dorchester Ave., Exposition Blvd.	Griffith Co.	G. E. Farnsworth	14.0
Katella Ave., Denni St., Los Alamitos Blvd., Farquhar Ave.	Griffith Co.	C. L. Gildersleeve	18.7
Chavez Ravine Rd., Coronel St. and connections	Griffith Co.	C. P. Montgomery	16.6
Dracaea Ave.—Rt. 19	George Herz & Co.	E. A. Bannister	12.8
3 mi. S. of March Field—Dracea Ave.	George Herz & Co.	E. A. Bannister	11.8
Waterman Ave.—Sterling Ave., on E. 3d St.	San Bernardino County	W. H. Crawford	11.4
Cherry Avenue—San Bernardino	George Herz & Co.	J. M. Hollister	8.5
Cottonwood Creek—Northerly	Basich Bros.	A. T. Moore	11.1
Benicia—3.2 miles north	Parish Bros.	A. K. Nulty	21.6
On 5th St. and H St., Benicia	Fredrickson & Watson	A. K. Nulty	32.8
Rt. 77—0.6 mile west	Arthur A. Johnson	C. R. Hagberg	27.0
		Average	14.6

ROAD MIX

Weott—0.5 mile north	J. L. Conner & Sons	H. M. Hansen	55.5
Wilder, Little Baldwin, Coja Creeks	Granite Construction Co.	G. L. Beckwith	34.2
Route 138—Gardner Field	Louis Biasotti & Son	C. F. Oliphant	19.6
Route 4 near Buhach—Merced Flying School	E. A. Forde	A. Hull	25.8
0.5 mi. W. of Mokelumne River—Terminous	Clyde W. Wood	A. N. Lund	26.8
		Average	25.5

ARMOR COAT

Watsonville—Rob Roy Junction	W. J. Wilkenson & H. B. Scott	A. Walsh	16.3

Highway Bridge Maintenance Involves Care of 4,633 Structures

(Continued from page 15)

each year, one prior to and once following the winter season. The maintenance superintendent inspects all structures in his territory at least once every three months. Defects noted which endanger traffic or the structure itself are reported by the district office to headquarters office and action is taken to protect traffic if an emergency exists, pending receipt of recommendations from the Bridge Department.

One 4-inch by 6-inch card for each bridge is kept in alphabetical order of counties and in increasing order of route number within a county. In any given route, the cards are filed in increasing order of BLM (Bridge Log Mile) which places them in order, along the route, in direction of the log.

These cards show, briefly, the engineering history and rating and condition of every structure as extracted from the regular bridge reports.

Bridge Posting

Bridge inspection reports recommending posting are forwarded to the district in which the bridge is located with instructions to post a written notice on the bridge stating the date and place of a public hearing; such notice is posted five days in advance of the date of hearing. The hearing is conducted by a licensed structural engineer of the Maintenance and Research Section who determines the required limits of the posting and makes a report to the Director of the Department of Public Works. The posting is enforced in accordance with Sections 516 and 715 of the Motor Vehicle Code.

BITUMINOUS TREATED SURFACES—RECORDS FOR 1943

PLANT MIX

Location	Contractor	Resident Engineer	Roughness Index Inches per Mile
Arcata—Eureka Section Base	John Carlin Construction Co.	L. A. Weymouth	20.8
Arcata—Clam Beach	Mercer Fraser Co.	H. N. Hansen	16.4
Lamoine—Holt Road (por.)	Clements & Co.	F. S. Saunders	21.3
Edgewood Road—1 miles north	Poulos & McEwen	P. F. Duffy	23.2
Cougar—Macdoel	Poulos & McEwen	P. F. Duffy	19.4
Redding Airdrome—Route 20	M. J. Ruddy & Son	A. A. Bigelow	19.9
0.5 mi. S. of Clear Creek—Redding Subway	A. Teichert & Co.	C. I. Brown	8.4
Redding—Bass Hill	M. J. Ruddy & Son	A. A. Bigelow	25.2
1 mi. E. of Weaverville—Fawn Lodge	Clements & Co.	W. H. Bartlett	36.8
Helena—Weaverville	Clements & Co.	W. H. Bartlett	22.4
Ides Ranch—State Line	Isbell Construction Co.	G. Sundman	16.6
Irrigation Canal—Reclamation Ditch	McGillivray Construction Co.	P. L. Dito	22.0
Truckee—State Line	Hemstreet & Bell	J. L. Foster	8.6
Baxter's Airport	Hemstreet & Bell	J. L. Foster	10.6
Lincoln—Wheatland	A. Teichert & Co.	R. I. Nicholson	22.6
Clarksville—Shingle Springs	McGillivray Construction Co.	A. C. Irish	19.7
Yuba City—Butte County Line	Hemstreet & Bell	R. I. Nicholson	13.9
Yolo County Line—4 miles South of Williams	Clements & Co.	A. C. Irish	20.6
Truckee—Nevada State Line	Hemstreet & Bell	J. L. Foster	9.3
So. Willow Ave., Pasado Ave.—Feather River Blvd.	Hemstreet & Bell	R. I. Nicholson	23.2
Route 3—Camp Kohler	A. Teichert & Co.	W. G. Remington	14.4
Danville—one mile north	Union Paving Co.	E. Carlstad	13.1
At South Verona Underpass	Dan Caputo	G. W. Levier	37.6
Butler Road, South San Francisco	L. C. Smith	A. Walsh	33.4
Harbor Street, Pittsburg	L. Biasotti & Son	J. H. Creed	26.4
Ignacio—Sears Point	A. G. Raisch	W. A. Rice	32.6
Hendy & E. California Aves., Sunnyvale	Union Paving Co.	A. Walsh	16.1
Industrial Way, South San Francisco	Union Paving Co.	C. T. Ledden	18.8
Vallejo & Fresno Aves., near Santa Rosa	C. M. Syar	G. H. Heberling	33.9
Near Waldo	N. M. Ball Sons	W. A. Rice	27.6
5th Ave., San Mateo—Redwood City	Union Paving Co.	J. H. Creed	15.6
Napa—Solano County Line	A. G. Raisch	J. H. Creed	18.0
Mountain House—Greenville	A. G. Raisch	G. A. Wildman	10.1
1.9 miles E. of Orinda Jct.—0.1 mile W. of Walnut Creek	Union Paving Co.	E. W. Herlinger	11.9
Walnut Creek—1 mile north of Danville	Lee J. Immel	E. Carlstad	13.2
Muir Station—Christie Underpass	Piazza & Huntley	F. W. Montell	14.5
Casmalia—Santa Maria	Fredrickson & Watson Co.	F. C. Weigel	18.4
Cebada Canyon—Reservation Boundary	Calowell Construction Co.	J. C. Adams	21.7
Salt—Lynden School	Brown, Doko & Baun	D. J. Faulkner	23.5
In Paso Robles	Granite Construction Co.	H. J. Holman	22.6
Castillo—Leadbetter Road, Santa Barbara	Fredrickson & Watson Co.	M. A. Dawson	25.0
Southerly Boundary—King City	Granite Construction Co.	H. J. Doggart	14.9
Santa Inez River—San Luis Obispo	Brown, Doko & Baun	H. J. Doggart	24.4
Santa Rita—San Benito River	Granite Construction Co.	H. J. Doggart	13.5
Blackstone Ave. at intersection Shields Ave.	Brown, Doko & Baun	H. W. Porter	28.3
Lemoore Flying School—Jct. Houston Ave.	Piazza & Huntley	C. F. Oliphant	15.6
Various locations, Tulare County	Piazza & Huntley	C. F. Oliphant	10.9
3.5 miles south of Bakersfield—Famosa	Griffith Company	F. W. Howard	13.7
Houston Avenue—Hub	Warren Southwest, Inc.	C. F. Oliphant	22.5
Ocean Ave., Huntington Beach, W. City Limits—E. City Limits	Sully Miller Contracting Co.	W. D. Eaton	17.3
[illegible] N. of Nauman Road—Calleguas Creek	G. W. Ellis	C. P. Montgomery	15.2
Santa Clara River Bridge—Santa Clara Ave.	G. W. Ellis	V. O. Shett	14.3
[illegible]—Irvine	Sully Miller Co.	R. Cooley	19.4
On Firestone Boulevard and Imperial Highway	Griffith Company	H. B. Lindley	20.4
Pearl Street, Sepulveda Blvd.—Centinela Ave.	Sparks & Mundo	C. N. Ainley	29.7
Harvard Street, Santa Paula—Main St.	G. W. Ellis	F. Noel	19.3
Redondo Blvd., El Segundo Blvd.—116th St., Century Blvd.—Manchester Ave.	Vido Kovacevich	C. N. Ainley	20.5
Bay St.—Harbor Blvd.—Newport Blvd.	Griffith Company	H. B. Lindley	22.7
[illegible] & streets near Hueneme	Basich Bros.	W. A. Norman	26.6
Rte. [illegible] Castaic Crk.—Los Alamos Crk., Rte. 23, [illegible] Palmdale	Schroeder & Co.	C. P. Montgomery	15.0
[illegible]—Ventura County Line	Schroeder & Co.	C. P. Montgomery	15.3
[illegible] Ventura Santa Barbara Co. Line	G. W. Ellis	F. Noel	15.4
[illegible] Calabasas—Newbury Park	Schroeder & Co.	C. P. Montgomery	15.9
[illegible]—Route 2	State forces	C. Gildersleeve	23.7
[illegible] St. [illegible]—S. Entrance Air Depot	San Bernardino County	J. M. Hollister	12.1
[illegible]	George Herz & Co.	J. M. Hollister	16.0
Pine C[illegible]	State forces	J. N. Stanley	8.6
Willow St., C[illegible] Ave., [illegible] Drive, Occidental Ave., B[illegible] Pa[illegible] Shipyard	Louis Biasotti & Son	E. L. Craun	21.2

BITUMINOUS TREATED SURFACES—RECORDS FOR 1943

PLANT MIX (Continued)

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		Average	[illegible]

ROAD MIX

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		Average	[illegible]

ARMOR COAT

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[illegible]	[illegible]	[illegible]	[illegible]
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		Average	[illegible]

Water Storage Behind Shasta Dam Exceeds Million Acre-Feet

[illegible]

HIGHWAY BIDS AND AWARDS FOR FEBRUARY — MARCH 1944

Federal Aid Highways Carry 56% of Traffic

The Federal Aid Highway System of approximately 226,000 miles comprises but 7.7 per cent of the total National road mileage. The composition of the Federal Aid System is such, however, that most of the Nation's important and heavily traveled routes are included in it, with the result that on this 7.7 per cent of road mileage is generated 56 per cent of the total vehicle miles traveling the Nation's highways. In other words, the Federal Aid System is only 1/13 of the Nation's road mileage and yet it carries well over one half of the Nation's travel.

Old Railroad Span Rebuilt to Make New Highway Bridge

Eighteen foot wide paved roadway now carries highway across Oak Run Creek

State of California

EARL WARREN, Governor

Department of Public Works

Headquarters Public Works Building Twelfth and N Streets Sacramento

CHARLES H. PURCELL, Director of Public Works

A. H. HENDERSON, Assistant Director

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CALIFORNIA STATE HIGHWAY SYSTEM

CALIFORNIA
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MAY-JUNE
1944

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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Refinancing Bay Bridge Debt Saves State $5,097,000 by Bond Sale at Lower Interest Rate

REFINANCING of the San Francisco-Oakland Bay Bridge with an estimated saving of $5,097,000 in interest costs was effected by the California Toll Bridge Authority on May 22d in line with the wishes of Governor Earl Warren, Chairman of the Authority.

Evidencing the Nation-wide interest of bond houses in the Bay Bridge, some 250 eastern and western firms desirous of participating in the new bond issue formed a syndicate headed by Blyth & Co., Inc., Mellon Securities Corp., Inc., Harriman Ripley & Co., Inc., and Lehman Bros. and Associates, which was awarded the $56,000,000 Refunding Bonds on the basis of their public bid averaging 1.96613 per cent interest. The proceeds will be used to retire on March 1, 1945, all of the old bonds which it is estimated will be outstanding on that date.

The Authority anticipates a further saving of $15,455,000 will be realized due to an excess of revenues over original financing estimates.

This excess of revenues over bond service requirements will enable the Bridge Authority to retire bonds sooner than required under the terms of the bond issue. In addition, the refinancing savings will permit the bonds to be paid off one year earlier than would otherwise have been possible.

As was pointed out by Governor Warren at the bid opening, if the present $6,000,000 annual bridge revenues are maintained, all of the Sinking Fund Bonds of the refunding issue will be redeemed by 1952 and the remaining Serial Bonds by March 1, 1955. If this rate of redemption is maintained, the effective rate of interest on the refunding issue will be approximately 2.11 per cent.

After March 1, 1945, the total indebtedness of the San Francisco-Oakland Bay Bridge will consist of the $56,000,000 of refunding bonds sold on May 22, 1944, plus an obligation to reimburse the State Highway Fund in the amount of $6,600,000 advanced from that Fund for the construction of approaches under Chapter 24, Statutes of 1933

AUTHORIZED ISSUE AND PURPOSE

The Authority initiated the refunding by adopting on May 5, 1944, a resolution authorizing the creation of an issue of not exceeding $60,000,000 principal amount of San Francisco-Oakland Bay Toll Bridge Revenue Bonds of California Toll Bridge Authority.

The bonds authorized under the resolution are designated generally as "San Francisco-Oakland Bay Toll Bridge Revenue Bonds," and are limited to $60,000,000 at any one time outstanding, consisting of $36,000,000 Serial Revenue Bonds and $24,000,000 Sinking Fund Revenue Bonds consisting of $20,000,000 due September 1, 1962, and $4,000,000 due September 1, 1963

As of March 1, 1944, the Authority had outstanding $57,070,000 (of an original authorization of $77,000,000 of which $73,000,000 par value bonds were issued) San Francisco-Oakland Bay Toll Bridge 4% Serial Revenue Bonds and 4% Series Sinking Fund Revenue Bonds secured until March 1, 1945, by an exclusive pledge of revenues of the San Francisco-Oakland Bay Bridge. These bonds were issued under a resolution of the Authority adopted April 21, 1938, as amended, and are subject to call and redemption as a whole on March 1, 1945.

The purpose of the new issue is to provide funds which, together with other funds available for that purpose, are calculated to be sufficient to redeem all of the outstanding bonds at the redemption price current on March 1, 1945, and to pay interest on the new bonds from June 1, 1944, to March 1, 1945, and expenses incidental to the issuance of the new bonds.

$56,000,000 IN BONDS SOLD

On May 22, 1944, the Authority, after due notice, sold $56,000,000 principal amount of the Bonds, including all of the $36,000,000 principal amount of Serial Bonds and $20,000,000 principal amount of the Sinking Fund Bonds due September 1, 1962. The remaining $4,000,000 principal amount of authorized Sinking Fund Bonds due September 1, 1963, will not be issued and sold unless revenues of the Bridge received prior to March 1, 1945, are below the present estimate of such revenues, and such additional $4,000,000 authorized principal amount of Sinking Fund Bonds will be issued and sold, in whole or in part, only to the extent necessary to provide sufficient funds to redeem and retire all of the old issue outstanding on said date.

The Department of Finance of the State of California has filed with the Authority its written agreement, approved by the State Board of Control, to purchase on or before March 1, 1945, $4,000,000 principal amount of said Sinking Fund Bonds due September 1, 1963, thereby assuring the Authority that such additional funds will be available, if required. The amount receivable from the sale of $56,000,000 principal amount of bonds will be $56,000,000, plus accrued interest.

Under the Resolution, the proceeds of the bonds are to be paid to the Fiscal Agent to be held in trust and paid out or allocated as follows:

(a) To be set aside in the Current Interest Fund, an amount sufficient to pay interest on all of the bonds from their date to March 1, 1945;

(b) $200,000 to be set aside for the account of the Authority for the payment of expenses incidental to the calling, retiring or payment of the outstanding 4% bonds to be refunded and the issuance of the bonds, any amount so set aside and not used for such purposes to be transferred to the Reserve Fund;

(c) The balance to be held in trust for the purchase, payment or redemption on or before March

Photo of California Toll Bridge Authority in Session at Sacramento, May 22, 1944

Members of the California Toll Bridge Authority pictured as they finished signing documents authorizing bond sale refinancin San Francisco-Oakland Bay Bridge. Left to right they are Ernest L. Adams; Lieutenant Governor Frederick F. Houser; Governo Earl Warren, chairman; Director of Public Works C. H. Purcell; Director of Finance James S. Dean

1, 1945, of all the outstanding 4% bonds to be refunded, except that the Fiscal Agent may invest any part thereof in U. S. Government obligations maturing not later than March 1, 1945, and may purchase any of the outstanding 4% bonds at a price not in excess of the redemption price including premium and accrued interest current on March 1, 1945. On March 1, 1945, the remaining balance, together with the proceeds of any such U. S. Government obligations and any outstanding bonds so purchased, is to be applied to the redemption of all the then outstanding 4% bonds and the payment of interest thereon [illegible] March 1, 1945.

[illegible] OF BONDS

The [illegible] principal amount of bonds of [illegible] authorized issue sold May 22, 1944, are dated June 1, 1944.

The Ser[illegible] B[illegible] bear interest payable sem[illegible] annual[illegible] March 1st and September 1st of each year, except the first [illegible] which is payable on M[illegible] 1, [illegible]. The principal amount [illegible] bon[illegible] [illegible]ing September 1, 1944, is $[illegible] [illegible] amount will [illegible]

semiannual maturity date until September 1, 1959, when the final installment of Serial Bonds in the sum of $1,460,000 will mature. Serial bonds maturing up to and including March 1, 1950, will bear interest at the rate of 3¼% per annum. From that date on until the final maturity on March 1, 1959, the Serial Bonds bear interest at the rate of 2% per annum.

The $20,000,000 principal amount of Sinking Fund Bonds bear interest at the rate of 1¾% per annum, and mature on September 1, 1962.

REDEMPTION TERMS

All of the bonds, or all of the Sinking Fund Bonds, are redeemable as a whole by the Authority on any date on or after March 1, 1950, and prior to maturity; the Serial Bonds are redeemable prior to maturity in part by the Authority on or after March 1, 1950 (but not prior to said date) in inverse order of maturities but only after or simultaneously with the retirement of all of the Sinking Fund Bonds, the Sinking Fund Bonds are redeemable in part by the Authority on or after September 1, 1945; in each case by lot on any interest payment date, but only out of funds available therefor under the Resolution, all on published notice of not less than 30 nor more than 60 days

and, at the following prices plus accrued interest: prior to March 1, 1947, 103½%; on or after that date and prior to March 1, 1949, 103%; on or after that date and prior to March 1, 1951, 102½%; on or after that date and prior to March 1, 1954, 102%; on or after that date and prior to March 1, 1957, 101½%; on and after that date and prior to March 1, 1960, 101%; and on and after that date and prior to September 1, 1962, 100½%.

An interesting sidelight of the opening of bids for the refinancing was a report submitted to the Bridge Authority by Lester Herrick and Herrick of San Francisco, certified public accountant to the Authority, showing that gross revenues including tolls and other income, of the bridge from November 12, 1936, the date on which the world-famous span was opened to traffic, to February 29, 1944, totaled $40,529,160.53.

NET REVENUES AND INTEREST

Net revenues after the deduction of expenses (other than bond interest), such as Use and Occupancy Insurance, fees and expenses of fiscal and other agents, revenue fund adjustments, principally refunds to the United States Government or its agencies for tolls paid, and uncollec

View of San Francisco-Oakland Bay Bridge looking westerly across the structure showing the City of San Francisco in the background

tible accounts receivable, amounted to $40,219,346.80.

Interest on bonds during this period amounted to $19,016,981.21, leaving an excess of revenues over charges against revenues of $21,202,365.56. Of this amount, $4,000,000 is held in a reserve fund, leaving $17,202,365.56, which has been used or will be available for the retirement of outstanding bonds.

The California Toll Bridge Authority is composed of the following officers of the State: Governor Earl Warren, Chairman; Lieutenant Governor Frederick F. Houser; Director of Public Works C. H. Purcell; Director of Finance James S. Dean and Ernest L. Adams, who was appointed a member by the Governor on April 4, 1944, to fill a vacancy created when by an Act of the 1943 Legislature, the Director of Public Works became ex officio chairman of the California Highway Commission. Previously the chairman of the commission had been by law a member of the Authority.

The following is a brief review of financing operations relating to the Bay Bridge culminating with the adoption by the Toll Bridge Authority on May 5, 1944, of the resolution authorizing the refinancing plan.

Prior to April 21, 1938, the Authority had issued $63,339,000 of 4¾% San Francisco-Oakland Bay Toll Bridge Revenue Bonds all of which were held by the Reconstruction Finance Corporation. By a resolution adopted April 21, 1938, the Authority authorized the creation of an issue of not to exceed $77,000,000 principal amount of Revenue Bonds of which $33,000,000 were 4% Serial Revenue Bonds due serially March 1, 1939 to 1964, inclusive, and $44,000,000 were 4¾% Sinking Fund Revenue Bonds due September 1, 1976.

All of the $33,000,000 Serial Revenue Bonds and $30,339,000 of the 4¾% Sinking Fund Revenue Bonds were delivered to the Reconstruction Finance Corporation in exchange for the $63,339,000 of 4¾% bonds then outstanding. Subsequently $9,661,000 of 4¾% Series Sinking Fund Revenue Bonds were issued to the Reconstruction Finance Corporation for cash which was applied to the completion of the Bridge Railway. The remaining $4,000,000 Sinking Fund Revenue Bonds which were reserved for the acquisition of certain competing ferries, were never issued.

By an amendment of the Bond Resolution adopted June 5, 1939, and effective June 22, 1939, the interest rate for the 4¾% Sinking Fund Revenue Bonds was reduced from 4¾% to

4%. Provision was also made for the redemption from unexpended Construction Fund moneys of $500,000 principal amount of Serial Revenue Bonds.

Effective June 22, 1939, the Reconstruction Finance Corporation sold $31,700,000 of 4% Serial Revenue Bonds due March 1, 1940, to March 1, 1964, inclusive, and $39,300,000 of 4% Sinking Fund Revenue Bonds due September 1, 1976, to a group of underwriters for par plus a premium of 4½ points and accrued interest. The Authority shared in the premium received to the extent of half of the premium over 101 or $1,065,000, which amount was applied to the redemption of $300,000 Serial Revenue Bonds and $700,000 Sinking Fund Revenue Bonds held by the Reconstruction Finance Corporation.

Since $500,000 Serial Revenue Bonds had matured on March 1, 1939, and were redeemed from revenues, the amount of bonds outstanding on June 22, 1939, was by these operations reduced to the $31,700,000 of Serial Revenue Bonds and $39,300,000 of Sinking Fund Revenue Bonds which were sold by the Reconstruction Finance Corporation to the underwriting syndicate.

$13,930,000 OF BONDS REDEEMED

From June 22, 1939, to May 5, 1944, Serial Revenue Bonds matured by their terms and were redeemed from revenues in an amount aggregating $2,100,000 reducing the amount of Serial Revenue Bonds outstanding on May 5, 1944, to $29,600,000. Also during the same period Sinking Fund Revenue Bonds in an amount aggregating $11,830,000 were either called for redemption by lot on various interest dates or were purchased from holders at not more than the call price.

These redemptions reduced the amount of Sinking Fund Revenue Bonds outstanding on May 5, 1944, to $27,470,000 and the total of both Serial Revenue Bonds and Sinking Fund Revenue Bonds outstanding on that date to $57,070,000.

In accordance with the terms of the resolution adopted May 5, 1944, $110,000 was on May 18, 1944, transferred from unexpended moneys in the Construction Fund to the Fiscal Agent to be used for the redemption on September 1, 1944, of Sinking Fund Revenue Bonds. It is estimated that this amount together with surplus revenues between March 1, 1944, and March 1, 1945, will be sufficient to redeem at the stated call prices $4,029,000 of Sinking Fund Revenue Bonds by March 1, 1945, reducing the amount of such bonds outstanding on that date to $23,441,000. Serial Revenue Bonds in the principal amount of $660,000 will mature by their terms on March 1, 1945, reducing the amount of such bonds outstanding on that date to $28,940,000. The total amount of both Serial Revenue Bonds and Sinking Fund Revenue Bonds which will be outstanding on March 1, 1945, is therefore estimated to be $52,381,000.

Comments on Bond Sale by Financial Pres[s]

EDITORIAL comment by leading eastern financial publications on the Bay Bridge refinancing has been highly complimentary to the California Toll Bridge Authority and Department of Public Works for the successful handling of the sale of the refunding bonds which are rated as high grade investment.

Moody's *Bond Survey* of New York City said:

"The California Toll Bridge Authority received bids on May 22d for the sale of $56,000,000 of callable refunding bonds of this Authority. The issue will comprise $36,000,000 serial bonds maturing semiannually September 1, 1945, through 1959, and $20,000,000 in term bonds due September 1, 1962.

"Purpose of the issue is to retire on March 1, 1945, at the call price of 105 the outstanding bonded debt.

FIRST LIEN SECURITY

"Security will consist of a first lien on the net earnings of the toll bridge crossing San Francisco Bay * * * Bond interest on the new issue is not expected to exceed $1,500,000 initially, while total debt service charges will average less than $4,000,000 annually.

"It is apparent that average net in the years 1940-44 would cover interest charges of $1,500,000 about 3.60 times, and total debt service charges of $4,000 about 1.46 times. * * * The indicated margin of protection for the new issue is good. Consequently, we think that this new issue is deserving of fairly high investment regard.

"Under current conditions, bridge and other highway revenue bonds are not rated by Moody's Investors Service."

HIGH EARNING POWER

The *Commercial and Financi[al] Chronicle* of New York City said:

"Purpose of the offering is to provi[de] for the redemption of approximate[ly] the same amount of San Francisc[o-] Oakland Bay Bridge revenue seri[al] and term 4s presently outstanding.

"As for the bridge itself, the fa[ct] that the amount of debt originall[y] outstanding has been reduced to th[e] extent of some $15,000,000 since Jun[e] 1939, indicates a formidable degre[e] of earning power and economic secu[r]ity. As the refunding issue will ob[]viously bear a considerably lowe[r] rate that the current 4 per cent figur[e] the spread between gross and net reve[]nues should be greatly widened."

DEFINITELY HIGH GRADE

Standard and Poor's *Bond Outlook* of New York City, said "the bridge is virtually a gross revenue project since operation and maintenance expenses are paid by the State. Insurance premiums and fiscal expenses of about $50,000 annually are the only charges taking precedence over debt service.

The San Francisco-Oakland Bay Bridge has proven its value in the traffic system of the San Francisco metropolitan area. In view of the established earning capacity of the project and the excellent coverage afforded, its obligations are considered definitely high grade."

MOST HIGHLY REGARDED

The *Bond Buyer* of New York City said:

"The municipal market faces a test of its strength during the next few weeks. In addition to some $50,000,000 to $60,000,000 bonds now on their shelves, new issues scheduled for public sale on dates preceding the opening of the Fifth War Loan Drive aggregate just about $140,000,000. * * *

"The first and by far largest item is the California Bridge issue sold Monday May 22d. This is a refunding operation and a substantial part of the $56,000,000 bonds are expected to be taken by the holders of the outstanding bonds. Also it is one of the most highly regarded of all public revenue bonds and is being offered in a highly favorable market. The bulk, if not all of this loan, should be put away quickly."

Freeways Relieve Traffic Congestion and Conserve Property Values

By FRED GRUMM, Assistant State Highway Engineer

This paper was delivered before the Los Angeles section of the American Society of Civil Engineers by Mr. Grumm at a meeting on April 12, 1944.

THE State Planning Survey which the Division of Highways is carrying on in cooperation with the Public Roads Administration, has revealed many interesting facts concerning the highway transportation system in California. We learn that the 12,637 miles of the State Highway System, which is about 12.7 per cent of the total rural public road mileage of the State, serves 71.2 per cent of all of the traffic on the rural roads.

The remaining 28.8 per cent of the rural traffic is taken care of by the 86,923 miles of county roads.

Of the 56,000,000 vehicle miles generated daily on the public roads and streets of California, about 45 per cent are on the State Highway System.

We find that 84.4 per cent of all the rural dwellings are located along surfaced roads.

We learn that there are numerous deficiencies in our highway transportation system. By diligent study, we have detailed these deficiencies, particularly on the State Highway System, so that we have a sound basis for the preparation of improvement programs.

It is not necessary to set forth a long list of these deficiencies. I would like to refer, however, to one general statement, because I believe it has a definite bearing on the subject under discussion. That general statement is:

Deficiencies on the State Highway System are not being corrected at the rate at which they are developing.

This is not a new situation brought on by the war. It was in effect before the war started and has been seriously aggravated by the war conditions. In 1939, we could actually detail this disparity between obsolescence and improvement as follows:

"Replacement of the rural State Highway System due to obsolescence and depreciation, is falling behind at the rate of 151 miles of road surface and 38 bridges each year."

Deficiencies, however, do not consist only of deteriorated surface or posted bridges, but also of increasingly deficient capacity with the resulting congestion.

Inadequate capacity results not only from insufficient width of pavement, but is caused also by the character of and the manner in which traffic moves or operates on the road. This movement can become quite confusing and conflicting and thus cause congestion.

When a highway is required to carry a fairly large volume of through traffic and also to serve, at the same time, a fairly large volume of local traffic—the kind that moves into and out of the parking areas or the business developments adjacent to the highway—congestion and conflict results. In other words, then, we have congestion resulting from a cause other than merely insufficient width of pavement.

The deficiency brought about by the development of abutting property; by inducing the character of use that produces frequent movements off and onto the highway, is probably one of the most serious and most difficult to correct.

"RIBBON DEVELOPMENT" DEFINED

We have several names for this situation. Some are hard names, but probably the one which describes it most effectively and recognizably is "ribbon development." This means the development of abutting property into commercial or business frontage. This induces the frequent on and off movements which are so detrimental to the capacity and efficiency of the highway.

It does not seem reasonable or equitable, if the motorist pays for the cost of our main thoroughfares and probably many others besides, that owners of the abutting property should be able to profit thereby, at no expense to themselves, while, at the same time, they destroy the efficiency and integrity of the traveling facility the motorist has paid for. The net result is that the motor vehicle owner pays for limited access roads, whether he gets them or not.

CONCEPTION OF FREEWAY

Pondering on the best methods of correcting the situation, one of the first reactions would be that it is unwise and futile to keep on expending material sums of money derived from motor vehicle taxes for highway improvement, without protecting such investment against the character of development which destroys its usefulness and makes its function obsolete. Carrying such thinking to a logical conclusion leads to a scheme whereby the abutting property is denied the right of unrestricted ingress and egress to the highway. That is the conception of the "Freeway."

How does the freeway correct this situation? How does it function?

Someone recently said: "Our cities are worth preserving." This implies that evidently failure and deterioration of the cities is imminent. It is true that cities have had troubles, and this situation extends back to some years before the war. The tabulation of these troubles makes rather an imposing list.

In this list, we find: (a) traffic congestion, (b) inadequate transportation facilities, (c) decadence of property values, (d) high assessment, (e) high tax rate with consequent tax delinquency, (f) blight, (g) growing deficits.

PROPERTY VALUES AFFECTED

In some of our larger municipalities, these troubles have progressed

Completed section of U. S. 101, a six-lane freeway through Cahuenga Pass with which proposed Hollywood Parkway will connect

sufficiently far so that the total of savings and trust funds invested in city property mortgages could not be liquidated from the sale of the property. In fact the plight of some of the cities has become nearly desperate. Anything that will help to cure some of these ills is, therefore, decidedly welcome.

Many of these city ills are closely allied to or are the result of some other deficiency or trouble. Traffic congestion results from inadequate transportation facilities and, in some way, has an influence on decentralization. This latter in turn produces reduction of property values, and so the vicious circle continues.

The expansion of cities followed later by decentralization is rather of a uniform pattern throughout the country. This may be illustrated by such cities as Baltimore, Washington and Chicago. Where growth and expansion have been more or less uncontrolled, or left to the tender mercies of the real estate subdivider, we find that it has taken place as ribbon development along the transportation arteries leading into or out of the nucleus or heart of the city. In Baltimore and Washington, for instance, this expansion along the transportation arterials flares out in all directions from the center.

In Chicago naturally it radiates from the city in all directions, except easterly toward the lake. An unfortunate condition accompanying this type of expansion is the leaving of undeveloped areas between the several ribbon developments along the highways.

This method of expansion of a city by development along the busy thoroughfares leading into and out of the heart of the original town, has brought about, in many instances, a development of business frontage far in excess of that required by the population. This development has also created another evil—traffic congestion.

Because it becomes a tedious and uncomfortable undertaking for the resident of one of the outlying districts to go to the central part of town for his needs, little community centers have sprung up and the development of commercial establishments supplying the immediate needs of the residents have developed at the several intersections. Gradually, in this manner, decentralization has progressed; and following it, there is often a deterioration in value of properties within the central portion of the city.

SOLUTION OF DECENTRALIZATION

Perhaps, then, if we can alleviate traffic congestion; if we can correct the inadequate transportation system; if we can supply the need of adequate facilities for uninterrupted travel in these areas of high traffic density, we may be able to remedy, or possibly to halt, the decentralization and the deterioration of property values, as well as provide safer and more comfortable means of transportation.

Freeways loom as a very appropriate, applicable solution of some of the transportation deficiencies in urban areas. Freeways can be designed expressly for urban use. They can extend to the various neighborhoods. A system of freeways can be coordinated with other travel arteries in such a manner as to correct the glaring transportation deficiencies and permit, at the same time, a remodeling of the city.

Freeways or expressways located to cooperate and satisfy the needs of a city have a force that is more effective than some of the other methods or tools designed for relief, such as zoning and planning. The development of a system of freeways can secure more desirable conditions and make for more comfortable living.

CITIES DIFFER IN FUNCTION

Such a system of freeways must be selected and designed as the result of a functional study of the city.

The problem in each city becomes individual, even though some general principles apply universally. We have talked blithely in the past about, and have actually by-passed cities with main thoroughfares. In some instances, such procedure has developed satisfactorily and has produced benefits. In other instances, however, the beneficial results have not been as complete as was desired.

That is because cities differ in function. Some cities are sources of origin or destinations for traffic in sufficient volume to require recognition. In other instances, they are simply a place along the road, probably not even a stopping place. On the other hand, we have also the situation that in a larger city there may be different areas which in themselves become sources of origin or destination centers.

Study of our transportation problem in any city, then, requires first a highly developed lands. Right of way, including the access rights, is expensive; ultimate construction particularly so, because it must include frequent grade separation structures and other features not usually required for the average surface road or highway.

This cost item directly influences our conclusion concerning the function of the proposed highway. Usually through traffic alone is insufficient in volume to justify the freeway construction through urban areas. It means that the project must be designed to include a certain amount of local traffic—local in the sense of originating in the general vicinity and not far removed from the locality.

The traffic we can consider as local and which can be profitably included sideration the discharge and distribution of this traffic from the freeway at the proper destination.

Our first step is to provide for its access to the freeway in the outlying areas. This, of course, is easily accomplished by inlets at proper locations, such as important street intersections. The second step, then, is to determine the destination of this traffic and provide ample and adequate opportunity for the exit movement.

This movement probably will occur in fairly large volume at certain hours of the day. In other words, when the commuter comes to work, the highway facility must be able to discharge vehicles at points close to the major business establishments and the larger employment centers. The off or exit ramps must be so designed that vehi-

View of section of Arroyo Seco Parkway, a six-lane freeway connecting the cities of Los Angeles and Pasadena

determination of its particular function.

In the consideration of a system of freeways, particularly through urban areas, one fact, uppermost in mind, concerns the expense involved in carrying such a facility through in the freeway service, would be that originating in the outlying residential areas and destined for the central business area.

Including this character of traffic as essential to and served by the freeway, immediately poses another con- cles can readily, and at practically top speed, leave the main freeway and, gradually decelerating, direct their course into the street system.

The major volume of such vehicle movement takes place usually in the morning hours when the commuter is

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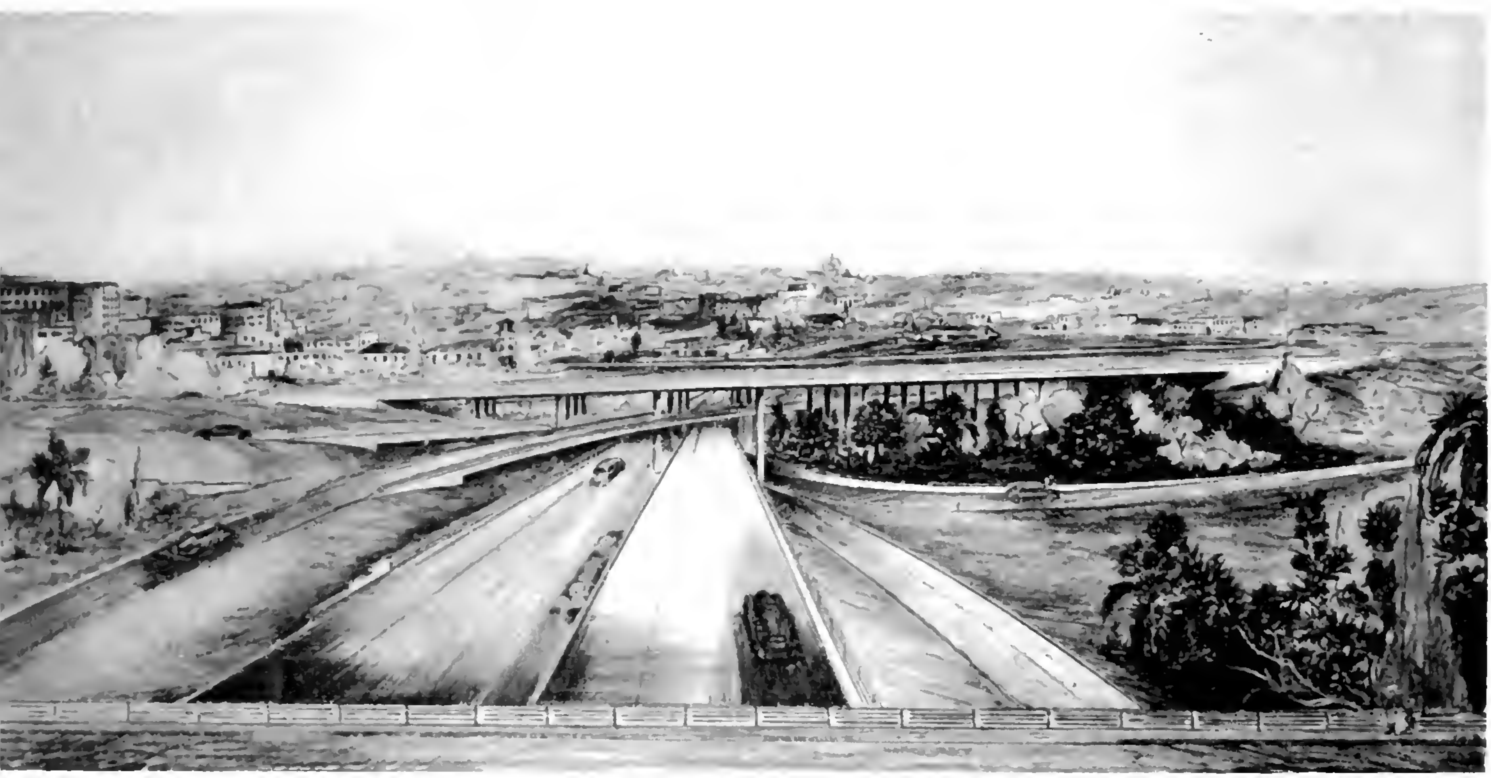
Four Level Grade Separation for Los Angeles Parkways Intersection

By S. V. CORTELYOU, District Engineer

A PARKWAY system to serve the Los Angeles metropolitan area has been the subject of exhaustive study over a long period of time. The location has been definitely fixed for many of these major traffic arteries. The more important of the



Artist's sketch of proposed 4-level grade separation in Los Angeles of State Highway 165, Arroyo Seco-Harbor Parkway, shown as the broad six-lane divided highway in center of picture and Route 2, Hollywood Parkway, crossing the picture at top level. The other roadways are traffic interchange connections with the two major arterials

parkways are on the State highway system and are expected to handle interregional and through traffic as well as the local travel.

In the development of plans and designs for parkways which will become a final responsibility on the State Division of Highways, this governmental agency has actively engaged for many months in studies of location and design in cooperation with the Los Angeles City Engineering Department.

Two of the major routes in this category are State Highway Route 2 and State Highway Route 165 and it is the intersection of these two important traffic arteries which is the subject of this discussion and the site of the proposed four-level grade separation.

State Highway Route 2 is one of the most important major highways in California. It is a main thoroughfare from San Francisco to San Diego and traverses the heart of Los Angeles from Cahuenga Pass in Hollywood to the Los Angeles Civic Center at Spring Street. This portion has been designated as the Hollywood Parkway.

CONNECTS SANTA ANA PARKWAY

From the Civic Center southeasterly this route is known as the Santa Ana Parkway and continues past a junction with the Ramona Parkway to Santa Ana and the South Coast region. For about 20 miles this Parkway is located in extensively built-up areas subject to great local traffic movement as well as to heavy long distance travel.

State Highway Route 165 extends from Pasadena through Los Angeles to the Harbor at San Pedro. It is known as the Arroyo Seco Parkway from Pasadena to the intersection with the Hollywood Parkway, and as the Harbor Parkway from this point southerly to San Pedro. This route traverses about 25 miles of intensively improved areas and is the lateral roadway connection between the City of Los Angeles and large cities on either side.

This intersection of the Hollywood Parkway and the Arroyo Seco-Harbor Parkway at the westerly fringe of the Los Angeles Civic Center area will be the most intensely used interchange point on the entire parkway network.

nce two of the most heavily traveled utes cross each other at a point in ose proximity to the center of business and governmental activity in the ty.

In recognition of the great significance of this interchange point, the gineers of both the city and the State ave given special study to many forms design in order to properly provide r the heavy exchange of traffic anticiated at the intersection.

State Division of Highways engiers have developed an entirely new pe of grade separation and interange system as an outgrowth of udies of the requirements at this site. nis new interchange system has been signated as a "Four-level grade paration" and embodies unusual features designed to increase safety, to duce traffic confusion, and to decease travel distances for interchange affic movements between Parkways.

The plan of the intersection clearly dicates that the method of handling change traffic between the two parkays is greatly simplified in comparin with the conventional types of interchange systems, as, for instance, the over-leaf type in which the left turn accomplished by means of a three-uarter of 270 loop to the right. In e clover-leaf type there is also an erlap of acceleration and deceleraon traffic with resulting conflict and nfusion. Other types of exchange stems employ reversing curvature and circuitous travel for some of the traffic movements, together with numerous bridge structures, all of which are detrimental to smooth and economical operation.

SIMPLIFIES TRAFFIC MOVEMENTS

The four-level grade separation eliminates these objectionable features by providing a simple turn for all traffic movements, in the direction in which each wishes to go and without excess distance over that which would be required in ordinary highway travel. It will be noted that the take-off from one parkway and junction with the other is in all cases made on the right side of the parkways, which is considered desirable on express type roadways.

In the four-level grade separation the basic feature is that the four separate roadway levels are so arranged as to pass one another at one point in a single bridge structure. The two major parkways intersect one another at approximately a right angle and on different levels, while two pairs of interchange roadways occupy a level each in positions bisecting the quadrants made by the main parkway crossing.

The lowest level is for the two 26-foot one-way roadways which handle the connections from the Harbor-Arroyo Seco Parkway to the Hollywood Parkway. The second level is the Harbor-Arroyo Seco Parkway which is a six-lane freeway with central dividing strip. The third level is for the two 26-foot one way roadways handling exchange from the Hollywood Parkway to the Harbor-Arroyo Seco Parkway. The fourth or highest level is the Hollywood Parkway, a six lane freeway with a 31-foot central dividing strip.

The resulting bridge structure is 69 feet in height from the lowest roadway to the highest roadway, of which about 47 feet will extend above the natural ground surface.

Advantage has been taken of the ground contours in working out the design. The lowest level will be depressed about 22 feet below natural ground surface, which is the limit to which it can be lowered and still obtain drainage by gravity flow to connect with the storm drain system. The second level, the Harbor-Arroyo Seco Parkway, will be at approximate ground surface. The third level is elevated in a manner similar to an ordinary overpass. The highest level, the Hollywood Parkway, is on a supported grade with a smooth profile which meets the higher ground on each side so that the resulting effect will be natural and pleasing.

Material for the approach fills is available from surplus excavation easterly on the Hollywood Parkway project, where the parkway is depressed for a considerable distance so that important city streets in the Civic

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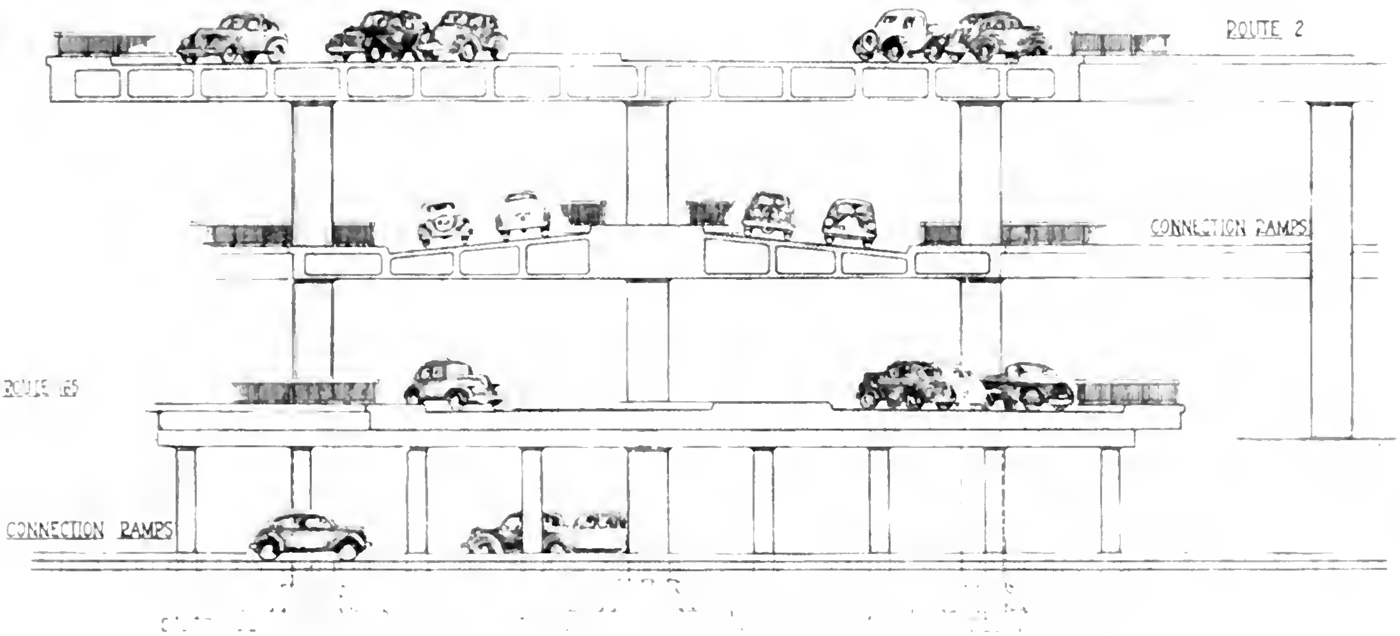

Cross section sketch of 4-level structure showing traffic on two major highway routes and interchange ramp connections crossing at one point

New Raw Materials Access Road Doubles Output of Lumber Mills

By M. C. FOSGATE, District Construction Engineer

IN the January-February 1944 issue of California Highways and Public Works appeared an article on a raw materials access project in Amador County which was constructed to expedite increased production and marketing of the war-needed output of that mountain region. This article covers a similar project located in Calaveras County that is nearing completion under contract with Claude C. Wood of Lodi who was the low bidder.

This project, which is 17.6 miles in length, is another splendid example of cooperation between the lumber and logging industries, Calaveras County, the Federal and State Governments as a contribution to the war effort.

The major industries participating are associated companies of the American Box Company, namely, the Stockton Box Company, Calaveras Forest Products Company, Associated Lumber and Box Company and the Blagen Lumber Company of which Walter S. Johnson is president and Charles Gray, the manager. We refer in this article hereafter to these various companies as the industry.

The county participation is through the Board of Supervisors of Calaveras County of which A. J. Gianelli is chairman and Claude T. Smith is supervisor for the territory between Mokelumne Hill and West Point and James S. Jack, supervisor between Toyon and Mokelumne Hill.

The cooperation of the Federal Government through C. C. Morris, District Engineer of the Public Roads Administration and Regional Forester S. B. Show of the U. S. Forest Service, consisted in the provision of Federal funds to finance the work and cooperation in field supervision.

The State's participation was to make preliminary studies, plan the work and supervise the actual construction under the high pressure required on any wartime project. A. N. Lund is resident engineer in charge of the project.

Preliminary agreements were entered into between the State and the industry and between the State and the county calling for the general participation in financing the work as follows:

The industry was to perform the clearing and actual grading work upon three important line changes:

1—From Toyon to a point approximately one-half mile northerly saving almost three-quarters of a mile in hauling logs and lumber to Toyon Mill on the railroad and over the main highway between Valley Springs and San Andreas, State Highway Route 24.

2—A major line change approximately 2.4 miles in length improving the alignment and the adverse grades of the section both sides of Mokelumne Hill.

3—A line change approximately one mile in length adjacent to the middle fork of the Mokelumne River near the northwesterly terminous of the project.

The county's participation in this project consisted of acquiring all rights of way for the three major line changes cleared and graded by the in-

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Construction equipment grading about 2.1 miles of line change on new route over Mokelumne Hill

At top—lumber trucks hauling heavy loads over steep grades and sharp turns on old road east of Mokelumne Hill before realignment. Center—big load of logs tops summit of McFadden Hill on new, wide highway. Bottom—view east of Flume House Hill on State Highway 5 where 10 per cent adverse grade was regraded to 7 per cent

Feather River Bridge near Auburn built in 1929, a 322-foot suspension span with steel cables resting in saddles supported by timber A-frame towers which became unsafe due to dry rot and decay in towers

Old Timber Bridge Towers Replaced by Steel Ones While Traffic Proceeds

By O. T. ILLERICH, Associate Bridge Engineer

IN the year 1866, at the height of the gold mining days of California, a privately owned toll suspension bridge spanned the canyon of the North Fork of the American River. The site was just below the junction with the Middle Fork, three miles east of Auburn where the old Mother Lode Highway to Forest Hill branched off to Pilot Hill, Georgetown and Sonora.

This venerable structure was replaced in 1929 by a 322-ft. suspension span with two main cables made up of four $1\frac{5}{8}$-inch diameter galvanized steel ropes resting in saddles on timber A-frame towers and carrying a timber deck and stiffening trusses.

The structure, a one-way bridge with a 12-foot clear roadway width, was located just east of the original bridge which was used as a detour during the construction work. Timber was utilized in the towers because this was considered a temporary site.

PROPOSED RESERVOIR SITE

The State Highway, a part of the Secondary Highway System, lies in a proposed reservoir site. This project was to have been completed by 1942, which allowed the span an estimated useful life of about 12 years. However, the present National emergency postponed this plan and the timber towers were called upon for service far beyond normal expectancy. Imminent failure due to incipient dry rot and decay made replacement necessary.

SADDLES JACKED OVER

It was not feasible to close the road to traffic during repairs, so a plan was devised to jack the saddles supporting the two cables onto new steel towers designed to support the dead and live load of 252,000 pounds per saddle. Two 50-ton jacks mounted on top of the existing A-frame towers were used to shove the loaded saddles onto the head plates of the steel tower legs.

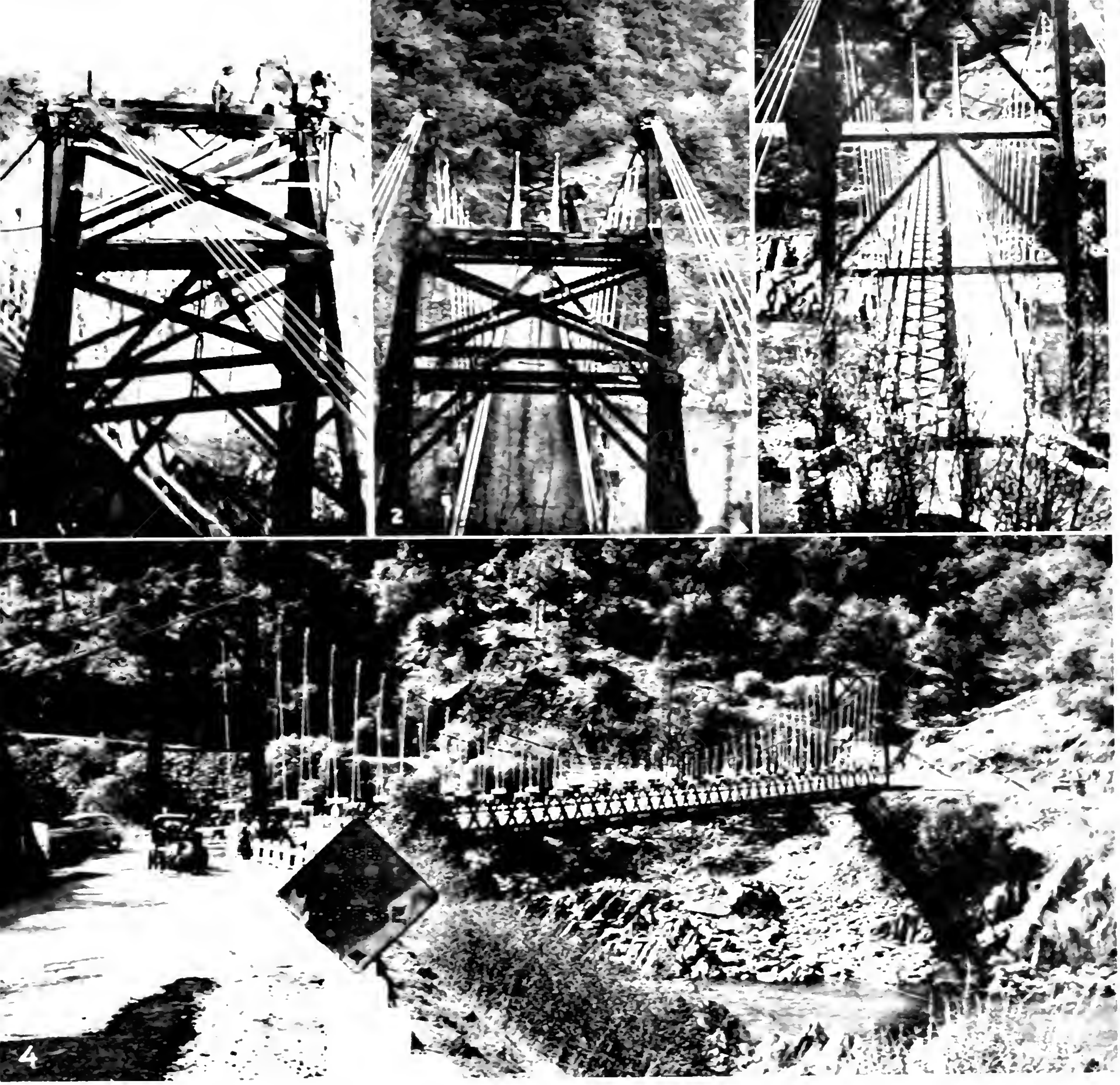
Each saddle represented a dead load of 134,000 pounds. Some resistance was met in overcoming friction due to the end grain of the wood in the posts and due to the horizontal components of the cable stresses. The cables were cradled from 14 feet center to center at midspan to 18 feet at the saddles.

An extension at each end of the existing concrete footing block carried the two-way rocker base assemblies on which were mounted the steel H-columns made up of 12-inch WF 28-pound beams riveted to the flanges of a 21-inch WF 59-pound beam.

PLACING STEEL TOWERS

Each column leg had to be threaded through the sides of the timber A-frame, coming to rest with its head plate just touching the under side of the saddle casting. The columns were then guyed in place and turnbuckles were used in the stays to control the required lateral movement.

After receiving the saddles, the tops of the steel columns were moved inward by rotating the legs on the lower transverse rocker assemblies so that the saddles again centered at 18 feet. To accomplish this the upper half of the timber A-frame had to be removed. The K-frame bracing connecting the tower legs was next erected and riveted into place. The



At top: 1—Crew jacking cable saddles from wooden A-frame towers to new steel tower legs. 2—Saddles have been shifted to new steel towers. 3—Job completed with A-frame towers removed. Bottom—Bridge as it appears strengthened and supported by new steel towers.

Freeways Relieve Traffic Congestion, Conserve Property Values

(Continued from page 7)

coming to work, and the exit facilities from the freeway, at that time, will have to function under peak volume. At the other end of the day, in the late afternoon hours, the operation is reversed—vehicles must find their way into the freeway to proceed back to their origin.

The entrance facilities to the freeway must, therefore, also be able to take care of a large volume within relatively short periods of time, even though their use during such periods may be more uniformly distributed than is the case of the outlet facilities at their peak period.

By thus combining the freeway, which we originally contemplated as the through traffic route, with service to local traffic, a sufficient volume is attracted and served to fully justify the large expenditures required in urban areas. The benefits derived by traffic from the installation of these facilities can be converted into values far beyond the cost of the improvement.

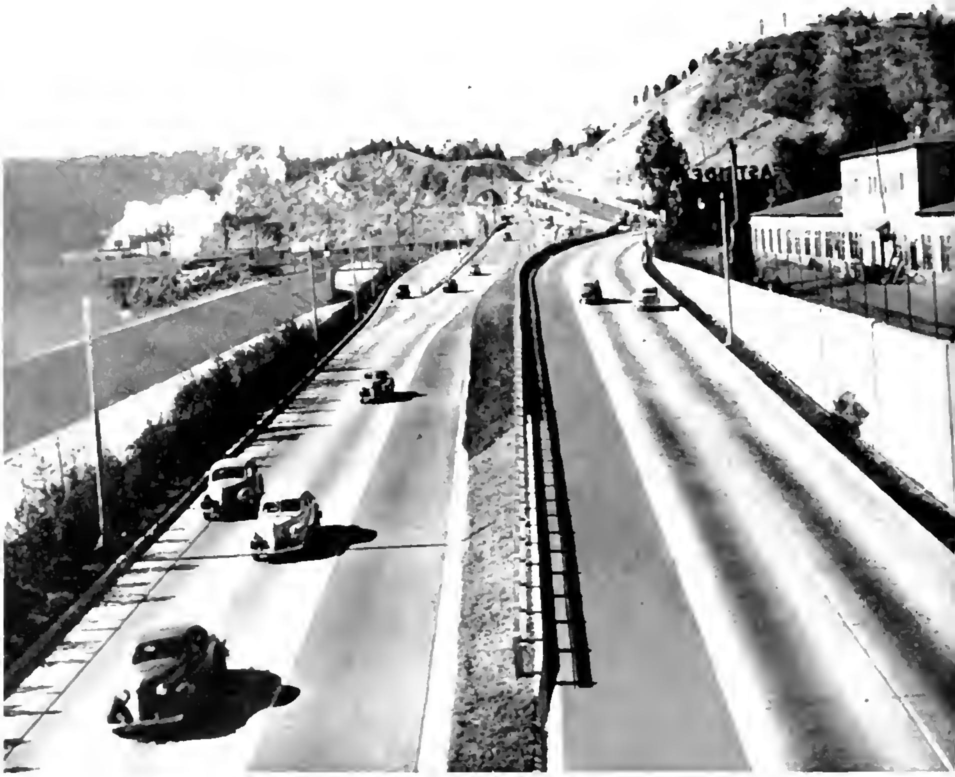
What are some of the advantages or benefits offered by freeways? We may enumerate some of these advantages:

(a) The freeway method preserves the efficiency of the road, the investment made by the motorist. Controlling the access to the highway prevents economic waste, particularly in urban areas where high values exist. Too frequently we have experienced the necessity of expanding the capacity of our major highways, only to find that, by reason of the previous improvement, property values have increased tremendously, and we are now confronted with paying much larger sums for the additional right of way required.

FREEWAY IS ECONOMIC SOLUTION

(b) The freeway is the economic method of achieving optimum transportation service. The facilities which are a part of the modern freeway make it possible for traffic to operate without interruption with greater comfort and safety, which means that the capacity of the roadway is greater and this capacity remains unimpaired.

(c) The high standard of development, separating cross traffic, preventing conflict between vehicles and between vehicles and pedestrians,



On the above section of Arroyo Seco Parkway opposing traffic proceeds on different levels separated by a railing and planted slope

makes for increased safety and accident reduction. Lives are saved, property protected and time is conserved.

(d) The freeway presents a means of providing for the proper functioning of the city in helping toward the determination of a better land use pattern. This would apply particularly to the outlying urban areas where they border on the outlying rural lands.

VALUE OF PROPERTY INCREASED

(e) The freeway principle takes the highway from under the influence of the adjacent land. Likewise the land is freed of the deleterious effects which traffic on a major road can produce. Transportation, therefore, can remain at an optimum, and abutting lands can be kept more comfortable, safer and cleaner. The value of the property is increased because it does not depreciate by reason of congestion, traffic noise, fumes, etc., but actually enjoys the benefit of being brought closer in time to the central business district while still remaining distantly separated.

These advantages apply particularly and more emphatically to freeways in urban areas. These advantages are not always reduced in effect or magnitude as the freeway extends from urban to rural area. It is at this fringe of the urban area, where it turns into rural land, that the first major benefits are realized—where the limitation of access can prevent the further extension of the ribbon development.

The invasion of the country by the city—setting up commercial establishments along the highway in strictly rural areas—is neither economical or necessary. The modern motor vehicle is capable of running several hundred miles with a tank full of gas.

The service stations scattered along the rural highways can be eliminated without discomfort to the motorist. Agricultural activity can be carried on with only nominal contact with

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Timber Bridge Trusses Rejuvenated With Reinforced Concrete Bearing Blocks

By JASON PLOWE, Associate Bridge Engineer

ANOTHER interesting illustration of one of the many ways in which the useful life of bridges as been extended during the warime emergency is found in the repairs made on the bridge across ndian Creek, a portion of the 'eather River Highway, about 10 iiles north of Quincy.

Reinforced concrete bearing blocks ave been installed to carry the hrust between the timber chord and 'eb members of the original trusses. The bridge consists of two timber eck truss spans of 114 feet on conrete piers and with timber trestle pproaches carrying a 24 foot roadvay. The original timber bearing locks had been crushed by the ressure of the web members, the russes had sagged, and complete ailure was imminent unless remedial ieasures were taken.

Timber bridge on Feather River Highway showing new concrete bearing blocks on truss members

NOVEL PROCEDURE

The chord and web members were till sound, so it was decided to repair he trusses by installing new bearing locks. This decision also conserved mportant amounts of critical mateials and labor that would have been ised if the bridge was to have been ompletely replaced.

The use of reinforced concrete earing blocks, a new experience in onnection with timber structures n the State highways, was decided pon after considering the difficulty f obtaining select grades of timber locks of suitable size due to wartime estrictions; and also the necessity of nstalling the new blocks to fit existng truss members, including large teel hanger rods which passed hrough the center of the blocks, ione of which were to be dismantled.

NO DETOUR AVAILABLE

In order to keep traffic rolling over he bridge without interruption, since here are no available detours in the ugged Feather River Canyon, the leck together with the upper chord, and the lower chord were first supported on temporary timber bents at each panel point. Web members were then blocked into place and the timber bearing block split up and removed. Hydraulic jacks were then used to lift the trusses back to their proper position.

Reinforcing bar assemblies were next put into position and forms built around the truss members at each panel point. Tie rods passing through the blocks were wrapped with two layers of asphalt paper. Portland cement concrete was tamped into place in the forms to give full contact against the truss members. The average size of the blocks is 2 foot 6 inches long, by 1 foot 6 inches wide and 1 foot 3 inches high.

INGENIOUS REPAIR SUCCESSFUL

After proper curing, forms were removed and truss tie rods tightened. Temporary bents were then removed, and again the trusses were self supporting.

Once again, wartime restrictions had given the bridge engineer the incentive to devise an ingenious means of repairing an important highway bridge with a minimum of material and labor. Early indications are that the concrete bearing blocks will be entirely satisfactory.

Reinforced concrete bearing block with 2 steel hanger rods through the center

The repair work was done under contract by Mr. C. C. Gildersleeve.

Mr. Roy Fetter was Resident Engineer for the Bridge Department of the Division of Highways.

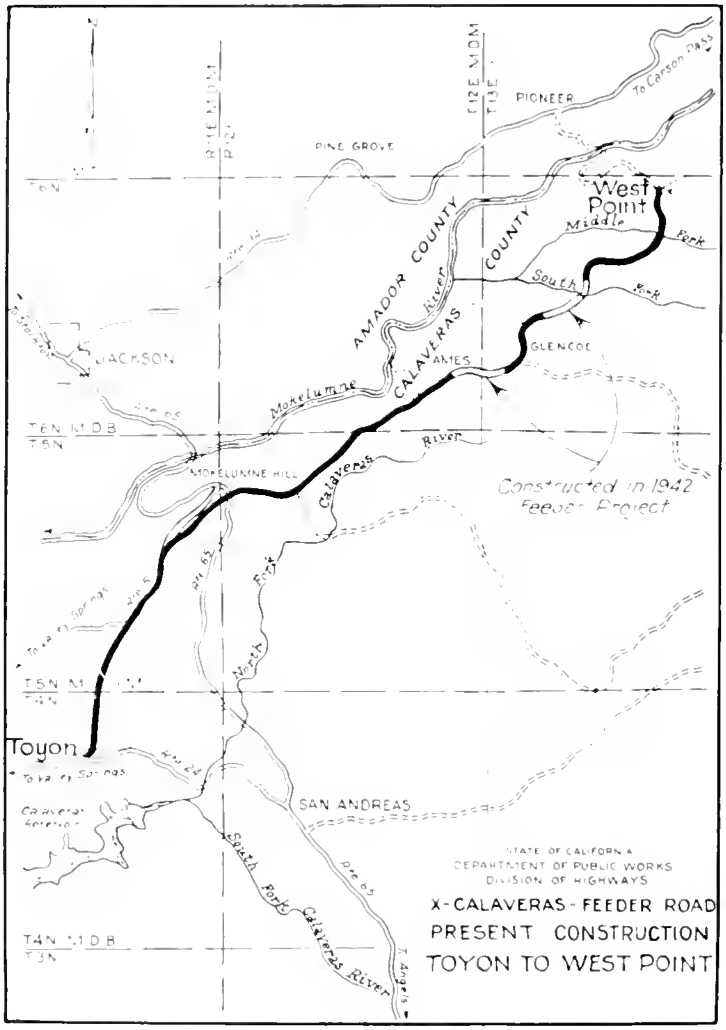
Girl, to soldier in train window: "Where are you going, boy?"

Soldier to girl on platform: "I can't go nowhere, gal, I'm being sent."

New Raw Materials Access Road Doubles Lumber Mills Output

(Continued from page 10)

dustry in addition to the rights of way of numerous other major and minor line changes throughout the entire length of the work constructed as a part of the project with Federal funds. County participation also included construction of two cattle passes and of numerous fences involved in acquisition of rights of way.



U. S. FUND PARTICIPATION

The financing provided by the Federal Government amounted to $322,300 for construction work exclusive of that performed by the industry and the right of way costs assumed by the county.

The road contract involves approximately 100,000 cubic yards of roadway excavation, 55,000 cubic yards of imported base material, 14,000 cubic yards of local mineral aggregate for road mixed surfacing, 217,000 square yards of mixing and compacting road mixed surfacing, 2,900 feet of pipe culvert and 1,800 tons of liquid asphalt.

The State in order to expedite construction in preliminary stages was required to depend on automobile and stadia surveys in order to determine quantities for advertising purposes.

The construction engineers were required to establish details of alignment and grades, balance quantity for roadway excavation and complete the cross section necessary to determine pay quantities as the work progressed.

The entire project may be described as a road 17.6 miles in length which begins at Toyon, which is a railroad shipping point on the Southern Pacific. From this point, the road traverses new rights of way for the first half-mile, where it intersects an old county road which it follows to its intersection with State Highway Route 5 at Mile 1. After proceeding along this State highway about two miles, the construction traverses new rights of way, via Stockton Hill, by-passing the town of Mokelumne Hill, just north of which, it crosses State Highway Route 65 and ties into the county road from Mokelumne Hill to West Point. It follows that road to within one mile of its northerly terminous where the construction is again on new rights of way.

NARROW ROAD, STEEP GRADES

The original county roads which this project will supersede were very narrow and almost a continuous series of curves with inadequate sight distances and grades up to 16 per cent. Over long stretches the road was too narrow to permit passing a vehicle and when meeting logging trucks, in most cases, it was necessary to stop on the wider places in the road. The surface had been reinforced at required spots and the entire section had received a penetration oil treatment.

Exceptions to the above poor alignment, adverse grades, and inadequate construction on the county road between Mokelumne Hill and West Point, are two completed Federal financed projects, totaling about six miles in length, and including a concrete bridge across the south fork of the Mokelumne River.

The new construction calls for a 26-foot graded roadbed with base reinforcement varying from 4 to 6 inches in thickness, according to the bearing value of the subgrade, and a minimum 20-foot width of 2-inch road-mixed surfacing. The new construction has reduced the grades in most cases to 7 per cent against the load with a few short stretches of 8 per cent.

GRADES AND CURVES REDUCED

When completed, this road will compare favorably with any of the State highways in this vicinity. The grades are not excessive; drainage structures have been installed; curves have been properly super-elevated; springs have been drained; the alignment has been inestimably improved by the reduction in curvature and the use of longer tangents; sharp curves and angles have been eliminated; sight distances improved; road safety has been increased; and the road may be traveled with ease and confidence.

An important section constructed under the contract was the so-called McFadden Hill line change which reduced existing adverse grades of as high as 15 per cent to a general 7 per cent with very minor short stretches of 8 per cent. This line change is one mile in length.

The industry operates two sawmills in the pine timber area, one of which lies easterly of West Point some four miles, and another located adjacent to the project at Sandy Gulch, which has gone into production this spring for the first time. A third mill is located at Toyon, the southerly terminous of

(Continued on page 20)

Four Level Highway Intersection for L. A.

(Continued from page 9)

'enter region may remain at present grade.

Alignment standards are excellent on both parkways, being on tangent at he bridge site with easy curvature adjacent. On the connections the lowest evel roadways are on tangent through he four-level structure with adjoining curvature radii of 350-450 feet, and 400-400 feet which will provide safe speeds on the interchange of 35 miles per hour or better.

The third level connecting roadways are both on 300-foot radius curves with safe speeds of 35 miles per hour. These curves would have had slightly longer radius except for an important obstruction in the form of a large school building where clearance is limited. While of shorter radius than the lowest level connection roadways, these curves are elevated and therefore have ample sight distance clearance.

Grade systems are good throughout, and meet requirements of design speed of 60 miles per hour on the parkways and 35 miles per hour at the interchange roadways. Near the bridge structure the Hollywood Parkway has a maximum grade of about 3 per cent, while on the Harbor-Arroyo Seco Parkway the maximum is a short stretch of 4.5 per cent grade. On the exchange roadways the grade varies.

The grade system demanded special care and study in its development largely on account of existing major streets on all sides of the four-level structure, which themselves required grade separations with the freeways and with the connecting roadways. These limitations made necessary a very careful adjustment of all grades and positions, since grade and alignment are interrelated and each affects the others.

It is proposed to construct the four-level bridge of reinforced concrete as this material will lend itself better to architectural treatment than would structural steel. The use of reinforced concrete will also be consistent with other nearby structures planned for the parkways. Reinforced concrete design requires a slightly higher overall structure due to the greater depth of girders and floor system which is required, but the small increase in total height is not considered objectionable.

The different levels of the bridge all show the influence of superelevation and the grade of the roadways which they carry or bridge, and in the final design these effects will be softened by proper architectural treatment of the soffit lines.

The structural design of the four-level bridge is based upon the use of nine main columns to carry the vertical loading which will be symmetrically placed and will extend from footing to the highest level, supporting the bridge decks of all levels except the lowest which is on the ground. The minimum vertical clearance for all roadways is held at 15 feet and horizontal clearance will be provided between curbs and columns.

It will be noted in the plan that the length of deck on the highest level bridge carrying the Hollywood Parkway obviates the necessity of using excessively high retaining walls. The use of retaining walls can not be entirely avoided but the design has been worked out so that there will be a minimum of wall and those required will not exceed 20 feet in height.

The area occupied by the site of the four-level bridge is an old district and buildings are out-moded and in many cases in disrepair. With the exception of the Custer School buildings, which are modern and which are preserved in the plan, there will be a benefit to the community by clearing out the old neighborhood and substituting a modern parkway facility which with proper landscape treatment will become a landmark of beauty and pride for the entire city.

The Hollywood Parkway from the Los Angeles Civic Center to a junction with the existing Cahuenga Park Freeway is regarded as an important freeway project in the Los Angeles metropolitan area. This unit will include the four-level grade separation and a portion of the Harbor Arroyo Seco Parkway. Postwar planning is proceeding at full speed.

The four-level grade separation which is believed to be a forward step in highway design is a development of an idea first suggested by District Location Engineer W. H. Irish. It is a design applicable to other sites, furnishing a compact, efficient and safe traffic exchange system, superior in many respects to most systems now in use, and at comparable cost where conditions justify this design.

Freeways End Congestion, Save Property Values

(Continued from page 14)

the adjacent highway. Limitation of access, still permitting the necessary highway contact, should cause no hardship nor be expensive. Agricultural use of adjacent land has the least detrimental effect on highway efficiency.

Acquisition of limited access while still providing reasonable access but confining the use of land to agriculture, will effectively protect the highway investment. It provides other benefits too: it protects the commercial establishments in the nearby urban areas; it prevents the wide, uneconomical spread of many small stores and shops.

BENEFITS CITY AND COUNTRY

It will help keep the city in the city and preserve the scenic values and the freedom of the countryside.

RENDERS SAFE, COMFORTABLE TRAFFIC

So, here too, in the country the freeway can advantageously fulfill its function: to render safe, comfortable, effective, unimpaired traffic service with economy.

It seems that we have really evolved a solution of our heavy-duty highway problem—a means of escaping from the hopeless, uneconomical dilemma into which we had fallen.

But as with everything that is of import to mankind—that is new—it is realized slowly. We must be discreet in applying this remedy. Vested property rights are still, next to human life, the most highly considered. If we push our freeway principle too urgently, we may have to pay high to establish it.

It is quite obvious that the most fertile field to produce benefits through the application of the freeway principle is in the city—in the high traffic density area. Even at the high cost we may encounter in establishing a freeway through a highly developed urban area, we are justified by the large benefits that soon become apparent.

Directly: Congestion is relieved; efficient, adequate traffic service is provided; hazard is reduced and safety increased; relief from driving strain and added comfort is found; time is saved and economy achieved.

Indirectly: Better living conditions are promoted; residential prop-

(Continued on page 20)

Highway Bids and Contract Awards for April and May 1944

ALAMEDA COUNTY Between 0.3 miles south of San Leandro and the north city limits of San Leandro, about 1.3 miles, to be repaired with asphalt concrete. District IV, Route 5, Sections D, Oakl, SLn. Gallagher & Burk, Oakland, $29,582; Clements & Co., Hayward, $29,655; Heafey-Moore Co., Oakland, $29,974; Independent Construction Co., Ltd., Oakland, $30,780; A. J. Raisch, San Jose, $32,160; Louis Biasotti & Son, Stockton, $32,555. Contract awarded to Lee J. Immel, Berkeley, $28,675.

ALAMEDA COUNTY Between Dublin and Castro Hill, (portions only) about 2.6 miles, to be repaired by surfacing with plant-mixed surfacing. District IV, Route 5, Section B. Lee J. Immel, Berkeley, $25,170; Chas. L. Harney, San Francisco, $25,525; Clements & Co., Hayward, $25,698; A. J. Raisch, San Jose, $25,990; N. M. Ball Sons, Berkeley, $27,102; A. A. Tieslan & Son, Berkeley, $28,550; Granite Construction Co., Watsonville, $28,660; Louis Biasotti & Son, Stockton, $30,350; Frederickson & Watson Construction Co., Oakland, $30,366. Contract awarded to W. C. Railing, Redwood City, $24,152.

EL DORADO COUNTY Repairing a bridge across the South Fork of the American River near Lotus. District III, Route 65, Section B. M. A. Jenkins, Sacramento, $14,130; A. Soda & Son, Oakland, $20,150. Contract awarded to J. & B. Rocca, Stockton, $9,769.

HUMBOLDT COUNTY Repairing a bridge on the South Fork of the Trinity River, one mile west of Salyer. District I, Route 20, Section D. Mercer, Fraser Co., Eureka, $12,245; James H. McFarland, San Francisco, $13,735; Fred J. Maurer & Son, San Francisco, $14,005; Carlton C. Gildersleeve, Willows, $14,671. Contract awarded to Kiss Crane Co., San Pablo, $11,637.

LOS ANGELES COUNTY—On Vanowen St. in the city of Burbank between Hollywood Way and Buena Vista Street, and on Clybourn Ave. in the city of Los Angeles, between Vanowen St. and Victory Blvd., about 1.2 miles to be graded and surfaced with plant-mixed surfacing. District VII. R. R. Hensler, Glendale, $33,957; Griffith Co., Los Angeles, $34,744; Arthur A. Johnson, Laguna Beach, $38,151; Schroeder & Co., Inc., Roscoe, $38,380; Clyde W. Wood, Inc., Los Angeles, $38,509; PGK Construction Co., Los Angeles, $41,616. Contract awarded to Warren Southwest Inc., Los Angeles, $28,852.

MENDOCINO COUNTY Between Wendling and Sonoma County line, about 4.4 miles, to be repaired with imported base material and a seal coat applied. District I, Route 48, Sections B, A, D. A. A. Tieslan & Son, Berkeley, $29,186; John C. Spaletta, Santa Rosa, $31,809; W. C. Railing, Redwood City, $32,773; A. J. Clausen, Berkeley, $33,745; Harold Smith, St. Helena, $36,660. Contract awarded to Elmer J. Warner and Ted Watkins, Stockton, $29,173.

MERCED COUNTY Between Madera County line and Merced, portions only, about 13 miles to be repaired with imported borrow, untreated rock base and plant-mixed surfacing. District X, Route 4, 123, Sections A, A. G. W. Ellis, North Hollywood, $129,727; Lester L. Rice, Marysville, $137,452; Frederickson Bros., Emeryville, $139,543; Piazza & Huntley, San Jose, $142,210; J. A. Casson Co., Hayward, $142,518; Elmer J. Warner, Stockton, $144,967; J. E. Haddock, Ltd., Pasadena, $148,303; Brown, Doko & Baun, Pismo Beach, $151,393; M. W. Stanfield Co., Los Angeles, $155,223; Granite Construction Co., Watsonville, $160,559; A. A. Tieslan & Son, Berkeley, $164,229; N. M. Ball Sons, Berkeley, $166,737; Frederickson & Watson Construction Co., Oakland, $180,600; Louis Biasotti & Son, Stockton, $191,789; Stolte, Inc., Oakland, $195,103; A. Teichert & Co., Sacramento, $199,782. Contract awarded to M. J. Ruddy & Son, Modesto, $124,475.50.

SACRAMENTO COUNTY For constructing pile dolphins and repairing the fender of a bridge across Steamboat Slough, 5.7 miles north of Walnut Grove. District III, Route 11, Section E. H. F. Lauritzen, Pittsburg, $11,390. Contract awarded to M. A. Jenkins, Sacramento, $9,435.

SAN BERNARDINO COUNTY—Between approximately 2 miles east of Newberry and 3.5 miles west of Hector, about 7.5 miles, to be repaired by placing plant-mixed surfacing over the existing surface and imported borrow on the shoulders. District VIII, Route 58, Section G. Basich Bros. Construction Co., Alhambra, $110,740; Oswald Bros., Los Angeles, $123,235; Pacific Rock & Gravel & M. W. Stanfield Co., Los Angeles, $139,635. Contract awarded to Geo. Herz & Co., San Bernardino, $91,795.

SAN DIEGO COUNTY—In the city of San Diego between Pacific Highway and Washington Street, about 1.0 mile to be graded and paved with asphalt concrete and portland cement concrete pavement. District XI, Douglas Street Extension. Griffith Co., Los Angeles, $343,888; Basich Bros. Construction Co., Alhambra, $350,113; Ralph A. Bell, San Marino, 388,411; V. R. Dennis Construction Co., San Diego, $414,424; Daley Corporation, San Diego, $482,649. Contract awarded to Ralph O. Dixson, Los Angeles, $326,646.

SAN JOAQUIN COUNTY Across San Joaquin River at Mossdale, the fenders of the existing bridge and the deck of the bascule span to be repaired. District X, Route 5, Section B. Pomeroy Simmck, Stockton, $49,109; The J. Philip Murphy Corp., San Francisco, $49,454; H. F. Lauritzen, Pittsburg, $50,787. Contract awarded to James H. McFarland, San Francisco, $31,999.

SAN JOAQUIN COUNTY Repairing deck of two bridges across Mosher Creek and Bear Creek between 9 and 11 miles northeast of Stockton, respectively. District X, Route 97, Section A. J. L. Webster, Lodi, $12,797; Earl W. Heple, San Jose, $9,729; Fred D. Kyle, Los Angeles, $13,362; J. & B. Rocca, Stockton, $8,950; Geo. M. Carr, Santa Rosa, $9,175; A. Soda & Son, Oakland, $11,985; Lawrence Construction Co., Sacramento, $10,764; James H. McFarland, San Francisco, $11,010. Contract awarded to Wallace Engineering Co., Escalon, $8,208.

STANISLAUS AND MERCED COUNTIES Between Newman and Los Banos, portions only, about 10.8 miles, to be repaired with untreated rock base and plant mixed surfacing. District X, Route 41, Sections New, B, A, B. M. J. Ruddy & Son, Modesto, $115,000; Brown, Doko & Baun, Pismo Beach, $116,132; Piazza & Huntley, San Jose, $122,012; Granite Construction Co., Watsonville, $122,800; Louis Biasotti & Son, Stockton, $124,511; Frederickson & Watson Construction Co., Oakland, $125,432; McGillivray Construction Co., Sacramento, $127,470; Frederickson Bros., Emeryville, $130,250; A. J. Raisch, San Jose, $130,392; M. J. B. Construction Co., Stockton, $136,560. Contract awarded to W. C. Railing, Redwood City, $110,304.

STANISLAUS COUNTY Between San Joaquin County line and Crow's Landing and between San Joaquin County line and Modesto, portions only, a net length of about 13.1 miles to be repaired with imported borrow untreated rock base and plant-mixed surfacing. District X, Routes 41 and 110, Sections A, Pat, B, A, B. G. W. Ellis, North Hollywood, $180,328; Lee J. Immel, Berkeley, $219,551; A. J. Raisch, San Jose, $198,348; M. J. Ruddy & Son, Modesto, $175,032; Piazza & Huntley, San Jose, $175,600; Elmer J. Warner, Stockton, $182,376; Brown, Doko & Baun, Pismo Beach, $182,518; Frederickson Bros., Emeryville, $185,938; Louis Biasotti & Son, Stockton, $187,592; M. J. B. Construction Co., Stockton, $192,489; N. M. Ball Sons, Berkeley, $192,817; McGillivray Construction Co., Sacramento, $196,870; Frederickson-Watson Construction Co., Oakland, $197,481; J. A. Casson Co., Hayward, $199,401; Marshall S. Hanrahan, Redwood City, $219,500; Stolte, Inc., Oakland, $244,273. Contract awarded to George French, Jr., Stockton, $163,756.

SUTTER AND YUBA COUNTIES Between Sutter County Hospital and 1 mile north, between Tudor Road and Oswald, in Yuba City between Bridge Street and Colusa Avenue, and in Marysville between J Street and Feather River Bridge, about 6.5 miles in length, to be repaired with plant-mixed surfacing on existing roadbed with plant-mixed surfacing on new crusher run base, borders to be constructed of crusher run base on imported borrow and seal coat to be applied thereto. District III, Routes 3, 87, Sections A, Y, C, Mvl., B. Marshall S. Hanrahan, Redwood City, $68,362. Contract awarded to Lester L. Rice, Marysville, $66,952.

TEHAMA COUNTY Between 3 miles east of Paynes Creek and Mineral, about 16.7 miles to be repaired with plant-mixed material. District II, Route 29, Section B. Lester L. Rice, Marysville, $101,670; E. B. Bishop, Orland, $119,205; Clements & Co., Hayward, $126,030. Contract awarded Mercer Fraser Co., Eureka, $87,255.

YOLO AND COLUSA COUNTIES Portions between Bretona and Genevra, about 5.9 miles to be repaired with plant-mixed surfacing. District III, Route 7, Sections C, A. A. Teichert & Co., Sacramento, $34,746. Contract awarded to Clements & Co., Hayward, $27,248.

BIDS AND AWARDS FOR MAY 1944

ALAMEDA COUNTY Between San Joaquin County line and one mile west of Mountain House, about 2 miles long to be repaired by surfacing with plant-mixed surfacing. District IV, Route 5, Section A. Lee J. Immel, Berkeley, $20,628; Louis Biasotti & Son, Stockton, $21,075; A. J. Raisch, San Jose, $21,654; Chas. L. Harney, San Francisco, $24,423. Contract awarded to A. A. Tieslan & Son, Berkeley, $19,544.

CONTRA COSTA COUNTY—On State Highway Route 75 between the junction with Route 106 and 2.5 miles east of Antioch, portions only, about 7.5 miles to be repaired with crusher run base and plant-mixed surfacing. District IV, Route 75, Sections B, C, Ant. Piazza & Huntley, San Jose, $142,131; Lee J. Immel, Berkeley, $148,357; M. J. B. Construction Co., Stockton, $168,481; Chas. L. Harney, San Francisco, $182,597; J. R. Reeves, Sacramento, $191,163. Contract awarded to A. J. Raisch, San Jose, $134,170.

FRESNO COUNTY Between Oil King School and Huron Road and between Hub and 4.6 miles northerly, portions about 11.7 miles in length to be repaired by constructing borders of untreated rock base material, placing plant-mixed surfacing over the existing surfacing and new borders and applying seal coat thereto. District IV, Routes 10, 125, Sections E, A. Piazza & Huntley, San Jose, $81,768; J. E. Haddock, Ltd., Pasadena, $87,444; M. W. Stanfield Company, Los Angeles, $99,863. Contract awarded to Brown, Doko & Baun, Pismo Beach, $80,070.

HUMBOLDT COUNTY—Between North Scotia Bridge and Fortuna, portions only, a net distance of 3.7 miles to be repaired by widening a portion with gravel base, placing plant-mixed surfacing over existing surfacing and new borders and applying seal coat thereto. District I, Route 1, Sections E, F. Clements & Co., Hayward, $51,040.

Contract awarded to Mercer Fraser Co., Eureka, $49,717.

IMPERIAL COUNTY—Between Dixieland and 2 miles east of Seeley and between El Centro and Meloland, portions only, about 10.9 miles to be repaired with road-mixed surfacing. District XI, Routes 12, 27, Sections C, ECn, C. Basich Bros. Construction Co., Alhambra, $50,152; Ventura Engineering Co., Los Angeles, $54,219; Vinnell Co., Alhambra, $54,866; R. E. Hazard & Sons Contracting Co., San Diego, $54,120; Clyde W. Wood, Inc., Los Angeles, $75,824. Contract awarded to Arthur A. Johnson, Laguna Beach, $48,198.

INYO-MONO COUNTIES—Between Bishop and Coleville, portions, about 44.3 miles to be repaired by applying a seal coat and screenings to be stockpiled. District IX, Route 23. Ventura Engineering Co., Los Angeles, $60,190; Vinnell Company, Alhambra, $60,295; A. A. Tieslau & Son, Berkeley, $69,743. Contract awarded to Basich Bros. Construction Co., Alhambra, $55,892.

KERN COUNTY—Between Maricopa and 3 miles east, between 6.2 miles west of Route 4 and Route 4, and between 0.5 mile and 6.5 miles east of Kern River, about 15.2 miles to be repaired by placing plant-mixed surfacing and applying an asphaltic emulsion seal thereto. District VI, Routes 57, 140, Sections BC, B. J. E. Haddock, Ltd., Pasadena, $103,679; Pacific Rock & Gravel Co. and M. W. Stanfield Co., Los Angeles, $128,665. Contract awarded to Griffith Co., Los Angeles, $96,627.

KERN COUNTY—Between one mile east of Blackwells Corner and Semitropic School, about 16.2 miles to be repaired with road-mixed surfacing and seal. District VI, Route 33, Sections B, C. J. E. Haddock, Ltd., Pasadena, $57,795; Arthur A. Johnson, Laguna Beach, $58,605; Pacific Rock & Gravel Co. & M. W. Stanfield Co., Los Angeles, $60,952; Brown, Doko & Baun, Pismo Beach, $64,151; Phoenix Construction Co., Bakersfield, $67,760; Griffith Co., Los Angeles, $68,980; Bressi & Bevanda Constructors, Inc., Los Angeles, $80,120. Contract awarded to R. R. Hensler, Glendale, $48,464.

KINGS COUNTY—Lemoore Flying School to Houston Avenue, about 10.8 miles of seal coat to be applied. District VI, Route 10, Section B. Brown, Doko & Baun, Pismo Beach, $9,100. Contract awarded to A. A. Tieslau & Son, Berkeley, $7,700.

LASSEN AND MODOC COUNTIES—Between 4 miles southwest of Adin and 2.7 miles northeast of Rush Creek Bridge No. 3-03, about 12.2 miles to be repaired with plant-mixed material. District II, Route 28, Sections B, A. McGillivray Construction Co., Sacramento, $81,581; Guerin Bros., South San Francisco, $85,171; Isbell Construction Co., Reno, $88,731. Contract awarded to E. B. Bishop, Orland, $77,333.

LOS ANGELES COUNTY—In the city of Burbank between Buena Vista Street and north city limits, about 1 mile to be graded and surfaced with asphalt concrete. District VII, Route 4, Section Brb. Southwest Paving Co., Roscoe, $49,764; Griffith Co., Los Angeles, $50,862; Schroeder & Co., Inc., Roscoe, $51,050. Contract awarded to Oswald Bros., Los Angeles, $49,635.

LOS ANGELES COUNTY—Route 23 between Solamint and Acton Road, and Route 79 between Saugus and Newhall Junction, portions only, a length of about 16.2 miles to be repaired with plant mixed material. District VII, Routes 23, 79, Sections BCD, B. Southwest Paving Co., Roscoe, $79,687; J. E. Haddock, Ltd., Pasadena, $98,895; Griffith Co., Los Angeles, $100,603. Contract awarded to Schroeder & Co., Inc., Roscoe, $75,676.

LOS ANGELES COUNTY—Lakewood Boulevard between Firestone Boulevard and Telegraph Road, and Rosemead Boulevard between Santa Fe Railroad and Fawcett Avenue, about 2.9 miles, to be repaired with plant mixed material. District VII, Route 168, Section B. Griffith Co., Los Angeles, $28,091; M. W. Stanfield Co., Los Angeles, $28,660; Oswald Bros., Los Angeles, $28,883; J. E. Haddock, Ltd., Pasadena, $30,017. Contract awarded to Vido Kovacevich, South Gate, $27,180.

MADERA COUNTY—Between Madera and Merced County line, portions, about 7.3 miles in length, to be repaired with plant-mixed surfacing and a seal applied thereto. District VI, Route 4, Sections B, C. M. W. Stanfield Co., Los Angeles, $49,751; J. E. Haddock, Ltd., Pasadena, $51,426; Piazza & Huntley, San Jose, $53,032. Contract awarded to M. J. Ruddy & Son, Modesto, $41,543.

MARIN COUNTY—Between Belvedere Railroad Crossing and Tiburon, 0.4 mile, to be repaired with crusher run base and armor coat and penetration treatment applied thereto. District IV, Route 52, Section Blv, A. Lee J. Immel, Berkeley, $14,929; Peter Sorensen, Redwood City, $14,874; Chas. L. Harney, San Francisco, $15,738; E. A. Forde, San Anselmo, $16,028; Louis Biasotti & Son, Stockton, $18,444; Mocco Construction Co., Oakland, $19,267. Contract awarded to A. G. Raisch, San Francisco, $13,879.

MARIN COUNTY—Between Waldo and Golden Gate Bridge, portions only, about 3.4 miles long to be repaired with asphalt concrete. District IV, Route 1, Section D. Louis Biasotti & Son, Stockton, $72,742; Lee J. Immel, Berkeley, $73,830; E. A. Forde, San Anselmo, $78,007; Chas. L. Harney, San Francisco, $78,322; A. Teichert & Son, Inc., Sacramento, $81,442. Contract awarded to A. G. Raisch, San Francisco, $70,822.

MENDOCINO AND HUMBOLDT COUNTIES—Between Rattlesnake Summit and Garberville, portions only, a net distance of about 9.7 miles, to be repaired with plant-mixed surfacing and seal coat. District I, Route 1, Sections I, A. Mercer, Fraser Company, Eureka, $105,012. Contract awarded to Clements & Co., Hayward, $98,810.

MODOC COUNTY—Between 2.7 miles northeast of Rush Creek Bridge No. 3-03 and Chambers Ranch, about 21.8 miles, to be repaired with plant mixed material. District II, Route 28, Sections A, B. E. B. Bishop, Orland, $109,570; Clements & Co., Hayward, $114,231; Harms Bros., Sacramento, $120,770; Isbell Construction Company, Reno, $125,985. Contract awarded to McGillivray Construction Co., Sacramento, $98,053.

RIVERSIDE COUNTY—Between State Highway Route 26 and 1.2 miles south of Thermal, portions, about 9.6 miles to be repaired with road-mixed surfacing. District XI, Routes 203 and 187, Sections A, F. Arthur A. Johnson, Laguna Beach, $34,920; Ventura Engineering Co., Los Angeles, $34,951; R. R. Hensler, Glendale, $38,185; Oswald Bros., Los Angeles, $39,030; Ralph O. Dyson, Los Angeles, $40,532; Vinnell Co., Alhambra, $41,007; Clyde W. Wood, Inc., Los Angeles, $43,808; Phoenix Construction Co., Bakersfield, $45,640; Bressi & Bevanda Constructors, Inc., Los Angeles, $46,643; Western Dredging & Construction Co., Los Angeles, $48,297; J. E. Haddock, Ltd., Pasadena, $51,875. Contract awarded to Basich Bros., Alhambra, $31,855.

SACRAMENTO COUNTY—Repairing a bridge on the State highway across American River, ½ mile east of Sacramento. District III, Route 98, Section A. J. & B. Rocca, Stockton, $8,440; Lawrence Construction Co., Sacramento, $8,725; M. A. Jenkins, Sacramento, $8,742; Lord & Bishop, Sacramento, $8,932; Holdener Construction Co., Sacramento, $10,965; Kiss Crane Co., San Pablo, $11,550. Contract awarded to James H. McFarland, San Francisco, $6,186.

SANTA BARBARA AND SAN LUIS OBISPO COUNTIES—Portions between Gaviota Creek and Arroyo Grande, about 8.5 miles to be repaired with plant mixed material. District V, Route 2, Sections E, D, C, ML, F. Contract awarded to Brown, Doko & Baun, Pismo Beach, $51,540.

SAN BERNARDINO COUNTY—At Itz. Ditch, about 45 miles east of Essex, a timber bridge to be reconstructed. District VIII, Route 58, Section L. C. J. Paradis, Los Angeles, $10,189; J. E. Stearman, Glendale, $9,063; Bent Construction Co., Los Angeles, $9,634; Ralph A. Bell, San Marino, $9,642; Fred D. Kyle, Los Angeles, $9,542; Norman I. Fadel, N. Hollywood, $11,244. Contract awarded to R. R. Hensler, Glendale, $8,476.

SAN DIEGO COUNTY—Portions of State highway as follows: three bridges to be repaired, one across Otay River, one across South Channel Sweet Water River and one across North Channel Sweet Water River, between 1 and 6 miles south of National City. District XI, Route 2, Section F. Bent Construction Co., Los Angeles, $29,505; C

In Memoriam

LT. ROBERT LEE BARKWELL

First Lieutenant Robert Lee Barkwell, Assistant Highway Engineer in District II of the Division of Highways, was killed in action during the battle for the Marshall Islands, February 2, 1944, while serving with the United States Marine Corps as an assault engineer in charge of a demolition crew.

Lieutenant Barkwell was born in Stockton, California, on July 13, 1912, receiving his education in the elementary and high schools of Sacramento, graduating from the Sacramento Junior College with honors in 1932.

In August of 1932 he entered the service of the Division of Highways in District II, where he worked until he was commissioned as a Second Lieutenant in the Marine Corps. Lieutenant Barkwell reported for duty on November 30, 1942, at the Marine Base, San Diego, California. After completion of the officer's intensified training course, he was assigned to Camp Pendleton on February 2, 1943. He became a part of the 4th Marine Division upon its formation at this base. Thence followed thirteen months of intensified training, after which he was assigned to overseas duty.

As an assault engineer he successfully led his men in the battle for the Marshall Islands, which began on January 31st, and was hard at work demolishing pill box after pill box when he was killed by a random shot from a trench mortar.

Lieutenant Barkwell was a very congenial and friendly man and was held in high esteem by all of those who knew him. In his death the department loses a very faithful and capable employee.

He is survived by his wife, the former Dorothy J. Weitzenberg of Sacramento, his mother Mrs. Edith J. Barkwell of Los Angeles, his father J. L. Barkwell, Sacramento, his sister Mrs. Esther M. North, Sacramento, and a brother Earl L. Barkwell now serving with the United States Navy somewhere in the South Pacific.

—SEMPER FIDELIS—

[illegible] $31,000; Walter H. Bar[illegible], [illegible] Diego, $32,026; Contracting Engineers Co., Los Angeles, $31,045; Fred D. Ke[illegible], Los Angeles, $31,951; Ralph A. Bell, San Marino, $35,068; Oberg Bros., Inglewood, $37,215; Ralph O. Dyson, Los Angeles, $38,038; Byerts & Dunn, Los Angeles, $45,578. Contract awarded to J. G. Perham, Los Angeles, $24,768.

SAN JOAQUIN COUNTY—Between Tracy and Stockton, portions only, 23 miles, to be repaired with imported borrow and plant-mixed surfacing. District X, Route 5, Sections A, B. Louis Biasotti & Son, Stockton, $23,488; A. A. Tieslau & Son, Berkeley, $28,112; M. J. B. Construction Co., Stockton, $29,785. Contract awarded to George French, Jr., Stockton, $23,408.

SAN LUIS OBISPO COUNTY—Portions between San Luis Obispo and [illegible] miles south of Santa Margarita and between 2 miles east of Estrella River and [illegible] east of Cottonwood Pass Road, about 8.3 miles, to be repaired with plant-mixed surfacing. District V, Routes 2, 33, Sections D, BC. Brown, Doko & Baun, Pismo Beach, $53,880. Contract awarded to Granite Construction Co., Watsonville, $49,700.

SAN LUIS OBISPO COUNTY—Between 0.5 mile west of Pennington Creek and Morro Bay, about 5.6 miles, to be repaired by constructing borders of imported base material and placing plant-mixed surfacing over new borders and portions of existing pavement. District V, Route 56, Section D. Granite Construction Co., Watsonville, $46,845. Contract awarded to Brown, Doko & Baun, Pismo Beach, $41,419.

SANTA CRUZ COUNTY—Between Santa Cruz and Davenport, portions only, about 6.2 miles, to be repaired by surfacing with plant-mixed surfacing. District IV, Route 56, Section B. Granite Construction Co., Watsonville, $59,925; Piazza & Huntley, San Jose, $60,975; N. M. Ball Sons, Berkeley, $62,891; E. A. Forde, San Anselmo, $71,660. Contract awarded to A. J. Raisch, San Jose, $55,981.

SOLANO COUNTY—Between 0.8 mile west of Fairfield and east city limit of Suisun, portions only, about 1.2 miles, to be repaired with untreated rock base and plant-mixed surfacing. District X, Routes 7, 53, Sections B, [illegible]. Lee J. Immel, Berkeley, $21,805; A. G. Raisch, San Francisco, $26,262; A. A. Tieslau & Son, Berkeley, $25,096; Piazza & Huntley, San Jose, $28,527; E. A. Forde, San Anselmo, $29,031. Contract awarded to [illegible], Suisun, $23,985.

SOLANO COUNTY—Across Napa River at west city limits of Vallejo, the fenders and piers of the existing bridge to be repaired. District X, Route 208, Section A. H. F. [illegible], Pittsburg, $25,475. Contract awarded to J. D. Procter Inc., San Francisco, $20,587.

STANISLAUS COUNTY—At [illegible] General Hospital, about 0.8 mile, to be widened and surfaced with plant-mixed surfacing on crusher run base. District X. M. J. Ruddy & Son, Modesto, $30,363; M. J. B. Construction Co., Stockton, $26,072. Contract awarded to A. A. Tieslau & Son, Berkeley, $2[illegible],751.

TRINITY COUNTY—[illegible] gravel near [illegible] west of Douglas City. [illegible] Route 20, Section [illegible] Bros., [illegible], $16,590. Contract [illegible], $12[illegible]

[illegible] COUNTY—Between [illegible] and 0.5 mile [illegible] Angeles, $54[illegible] $58,11[illegible] Doko & Baun, [illegible]

Highway Commission Votes Additional Funds For Roadway Repairs

THE California Highway Commission, returning from a three-day tour of the Redwood Empire to study at first hand postwar highway construction projects contemplated in Marin, Sonoma, Mendocino, Lake, and Napa counties, met in Sacramento June 12th and voted funds totaling $83,802 for the following highway repair jobs.

Monterey County, State Route 56—$1,000 to provide funds for repairing the bridges across Vicente Creek and Limekiln Creek.

Ventura County, State Route 9—$30,000 to provide additional funds for repairing the Santa Clara River bridge at Saticoy.

Alameda County, State Route 5—$30,000 from the contingency reserve, for repairing the present pavement between the Toll Plaza and the San Francisco-Oakland Bay Bridge.

Riverside County, State Route 26—$13,000 for constructing a reinforced concrete culvert on the State highway east of Beaumont. The present culvert is inadequate.

Kern County, State Route 145—$6,000 for surveys and plans and right of way on proposed access highway project between Johannesburg and Randsburg Junction, and between two points 7.5 miles and 1.5 miles north of Inyokern. The Public Roads Administration has approved this project estimated to cost $116,000 with the understanding that the State will pay the cost of surveys and plans and right of way.

Sonoma County, State Route 1—$3,122 for repairing the present highway between Marin County line and 0.8 of a mile north, the sum of $9,000 was previously allocated for this project. The low bid received on May 31st was 33 per cent in excess of the estimate requiring additional funds.

Marin County, State Route 1—$70.78 to provide additional funds for repairing the present highway between San Rafael and Sonoma County line. The sum of $20,000 was previously allocated but the low bid received on May 31st was 33 per cent in excess of the estimate, requiring additional funds.

New Raw Materials Access Road Doubles Output of Lumber Mills

(Continued from page 16)

the project, about four miles east of Valley Springs.

WILL DOUBLE PRODUCTION

The industry estimates that it will produce some 72 million board feet per year from the West Point and Sandy Gulch mills compared to last year's production of 38 million feet. This is exclusive of the production at the Toyon mill which receives logs from both the West Point area and the Blagen Lumber Company's mill at White Pines near the Calaveras Big Trees on the Ebbett's Pass road. The total production, therefore, will run close to 110 million board feet.

Both logs and sawed lumber are hauled over this raw materials access road, the lumber coming from the two mills located at West Point and Sandy Gulch and logs being hauled to the Toyon mill. The lumber produced from this area is used principally for ammunition boxes or directly for the armed forces of the United States.

On March 22, 1944, at ceremonies open to the public in the San Andreas Town Hall, the Blagen Lumber Company was awarded the Army and Navy "E" by Colonel Kenneth M. Moore of the U. S. Army Engineers and Commander Kenneth A. Goodwin of the U. S. Navy.

Freeways Save Property Values

(Continued from page 17)

erty values are increased; decentralization is halted; decadence of business property is checked; equitable property values and taxes reestablished and stability achieved.

That sounds as if someone besides the motor vehicle user ought to help pay the bill. And so they can. If the property owner will be reasonable in his demands for right of way and access rights, willing to keep his business away from the major traffic artery—the freeway—then the motor vehicle owner will gladly foot the rest of the bill because he will not have to invest his money in vain; he will have his travel facility for good and all and save his investment too. For once there will be someone who can have his cake and eat it too!

State of California

EARL WARREN, Governor

Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

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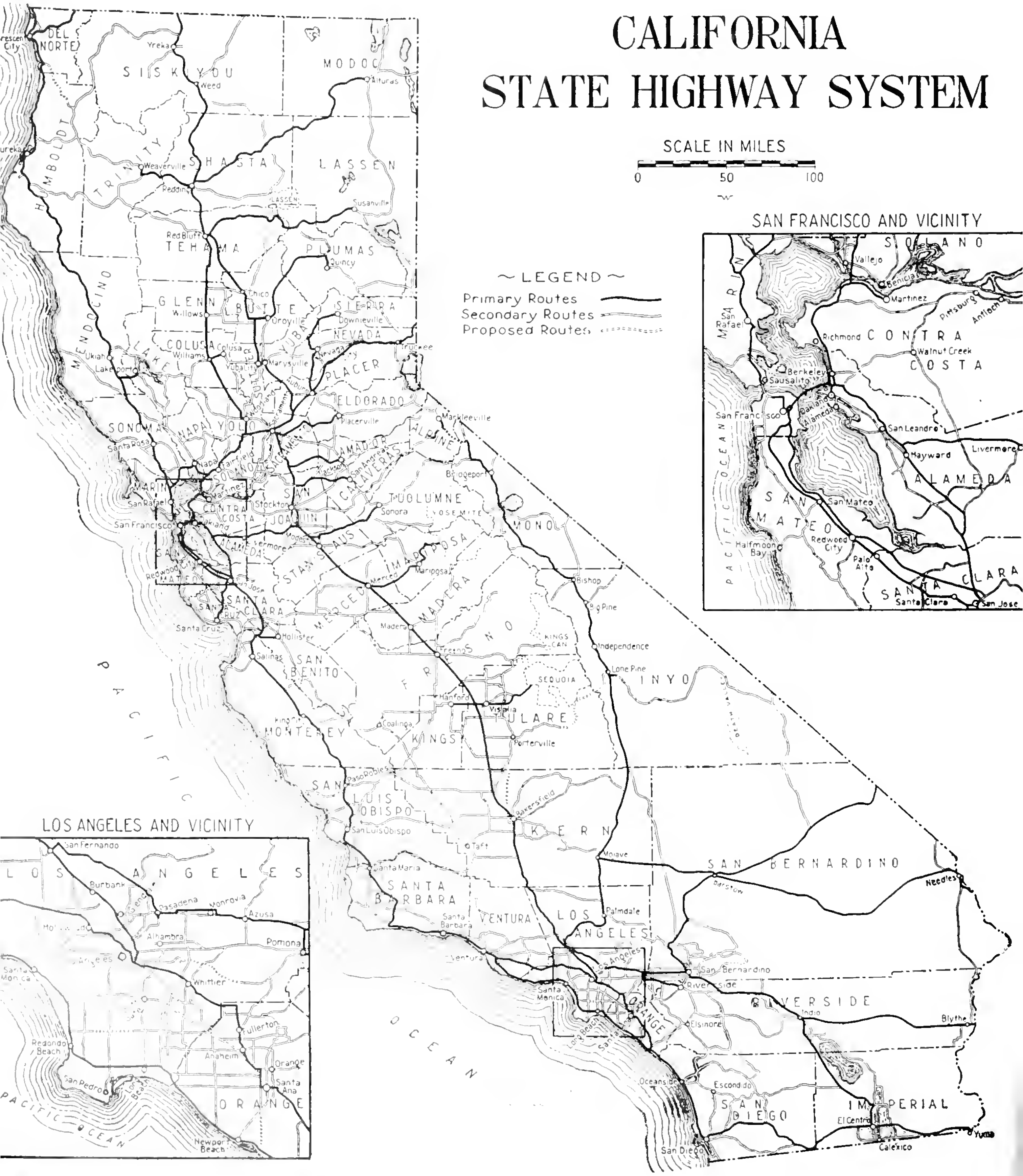
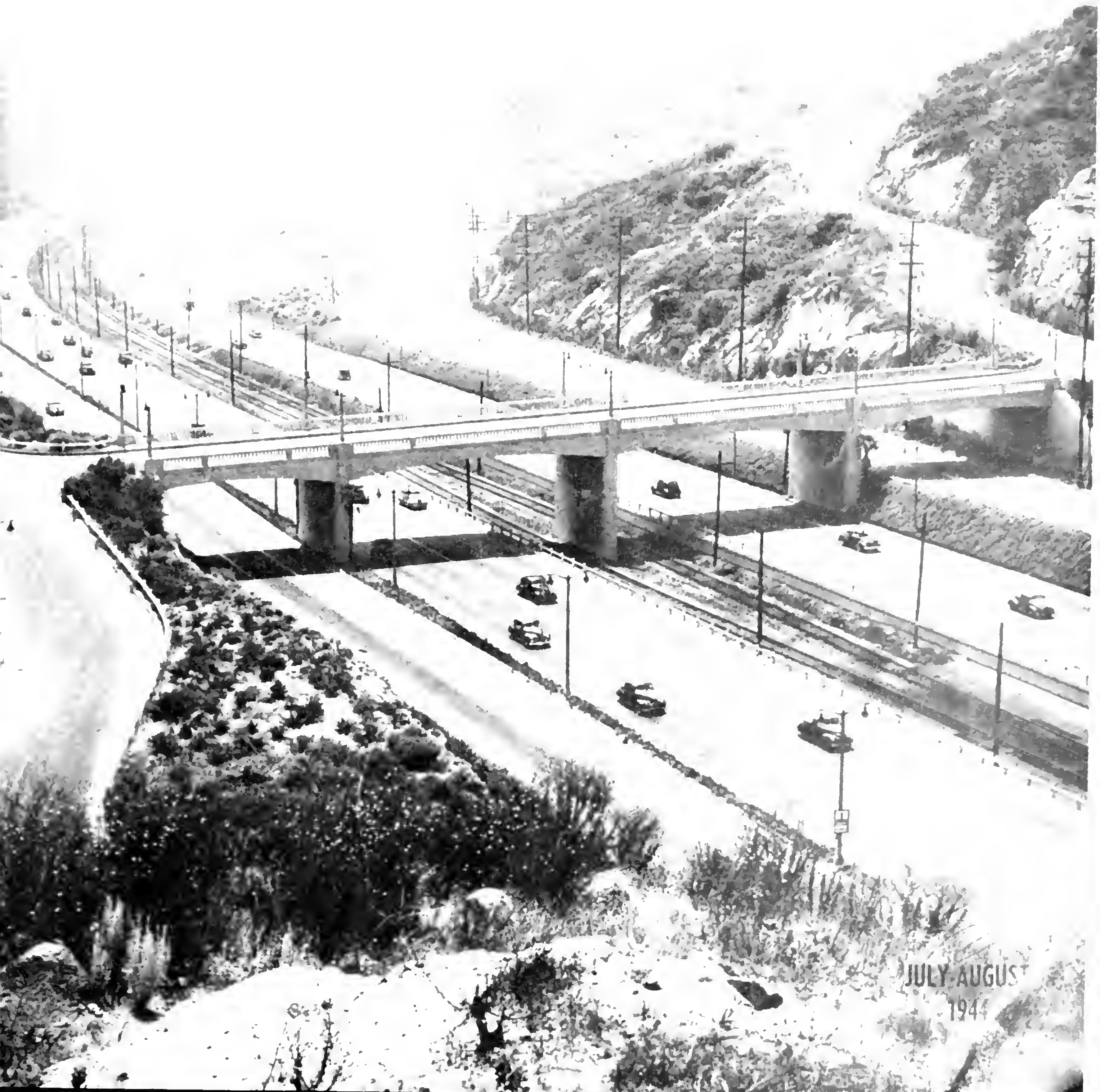


CALIFORNIA HIGHWAYS AND PUBLIC WORKS



JULY-AUGUS
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CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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Vol. 22 JULY-AUGUST, 1944 Nos. 7, 8

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Postwar Building Program Appears Likely to be Financed Before Actual Construction Begins

By ANSON BOYD, State Architect

THE postwar building construction program of the State of California will, in all likelihood, have money in the treasury to pay its costs, before actual construction begins. In adopting Governor Warren's program, the Legislature established a savings account for necessary construction work and as an employment reserve as follows:

Postwar Employment Fund (From 1943 Session, based on tax percentage)	$62,000,000
General Fund Surplus (From 1944 Special Session)	50,000,000
Total	$112,000,000

Distribution:

State Institutions	$40,000,000
State Education (Colleges and Special Schools)	11,000,000
University of California (Including contract plans)	25,600,000
State Office Buildings and Capitol	9,000,000
Correctional agencies	9,000,000
Veterans' Home	1,600,000
State Agricultural Society	1,600,000
Repairs to existing structures	4,000,000
Miscellaneous	1,000,000
Contract plans	3,250,000
Reserve	6,050,000

The farsighted program proposed early in the 1943 session of the Legislature by Governor Warren and generally based on survey material assembled on the Governor's instructions by the Director of Public Works, C. H. Purcell, is perhaps unique in the history of State financing in that:

a. The funds accumulate from current revenues during its preparation and generally leave future revenues free to meet future problems and investments.

b. Planning precedes actual appropriations—this is the reverse of past procedure and permits thorough understanding of the scope, implications and outlay of each project prior to commitment. If continued, this procedure may constitute the foundation for intelligent and businesslike long-term improvement investments on the part of the State.

TWO GROUPS

The State building program divides into two groups according to jurisdiction, namely, the projects proposed for the University of California which are under the control of the Board of Regents and the remaining group of projects which are executed by the Department of Public Works, Division of Architecture, according to law.

According to priority of planning the entire program is divided into "parts" which have been cleared and approved in conformity with law in the order that surveys and evaluations have been made. Parts I and II are in progress or completed; Part III is in process of authorization and succeeding parts will follow as authorized. The total sum represented by Parts I, II, and III is $33,248,900.

COOPERATIVE PROJECT

The entire planning program, in order to be effective, has been arranged as a joint coordinated and cooperative overall project with each of the principal agencies involved.

For purposes of illustration the State Department of Institutions operates nine sites for mental patients, three blind shops and one clinic. The resident population for the mental patients is 29,750 as of June 30, 1944, and a bed capacity of 5,154 less—this represents a drastic condition of present overcrowding. Each institution is generally similar to a city of equal population, having an administrative center, streets, bridges, water, telephone and electric systems, power house, sewage plant, laundry, warehouses, commissary, main food preparation buildings, shops, residential area, general psychiatric, medical and surgical hospital, auditorium, and usually a dairy herd serving two or more thousand people; swine, five to ten thousand laying hens and a general farm and orchards. Each of these activities in a community is a specialized field of business in itself and must be so regarded in State affairs.

MANY TYPES OF BUILDINGS

The organization of the program requires about 110 different purpose types of buildings for institutions, colleges, schools and corrective institutions and to that extent profitable to the State standardized in plan units or form.

The order of their erection as well as that of the water, power, laundry, feeding and other parallel services must naturally be gauged to the projected demand. This projected demand has been established within reasonable working limits by "experience" charting methods together with the probable factors which will affect the various agencies.

Again using the Department of Institutions for illustration, and to an applicable degree, similar program planning will affect the correctional agencies, this broad condition exists— more than half of all community hospital beds, not including war casualties, are for the mentally ill. The dollar investment in a mental hospital bed is somewhat less than half that of a standard general hospital bed. The latter is occupied by about ten times as many patients in the same length of time in relation to its cost than a mental hospital bed. Therefore, and in part to counteract this disparity in use, large psychiatric acute treatment hospitals are being planned and a treatment study clinic proposed at Los Angeles in addition to that built in San Francisco for the purpose of accelerating cures and methods.

MASTER PLAN

Basically the master plan must provide the potential to reduce the fundamental risk to a mental patient wherein he differs from an ordinary illness—generally most physical ills are curable to the extent that the

(Continued on page 10)

Ramona and Santa Ana Parkways Proposed for Los Angeles Area

By S. V. CORTELYOU, District Engineer

RAMONA Parkway is one of the most important of the freeways proposed for construction in the Los Angeles metropolitan area as soon as finances and other conditions permit. It will be a modern freeway type traffic artery.

This parkway starts at the traffic interchange system at the easterly end of the Aliso Street grade separation in Los Angeles and extends easterly via Alhambra, El Monte, West Covina, to Pomona. The freeway passing under the Macy Street and other bridges in the City of Los Angeles will follow along the Covina line of the Pacific Electric Railway easterly through Alhambra to El Monte and thence easterly, generally along the existing alignment of State Highway Route 26.

Traffic from the proposed Ramona Parkway will enter the Civic Center and downtown area of Los Angeles by way of Aliso Street over the new Aliso Street viaduct. The viaduct and Aliso Street connection to the Civic Center are on State Highway Route 2, and known from Main Street easterly as

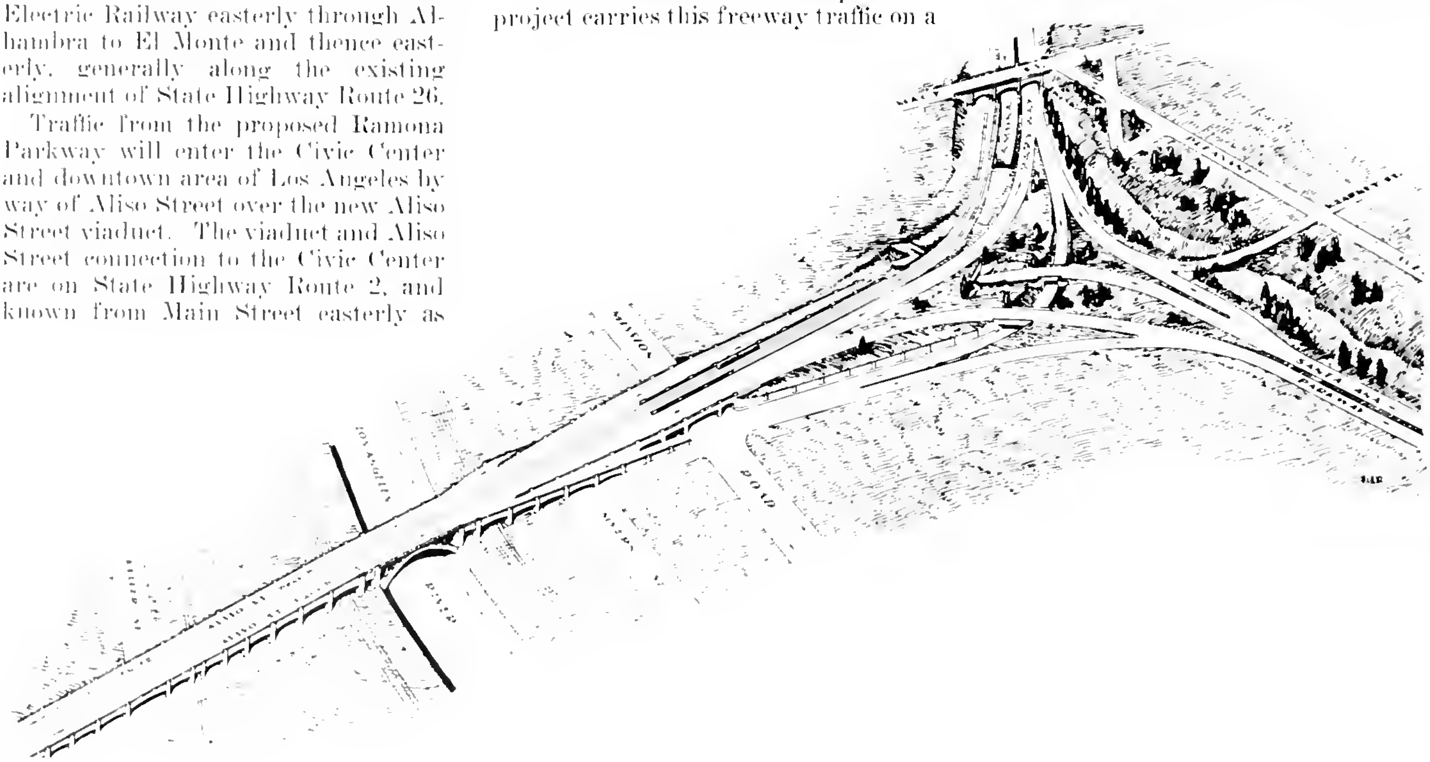
From the traffic interchange at the easterly end of the Aliso Street grade separation, the route of the Santa Ana Parkway turns southerly along the Boyle Heights bluff to a point south of Seventh Street, the freeway going over First Street and under Fourth Street, Sixth Street, Seventh Street and Boyle Avenue. It then turns southeasterly between Olympic Boulevard and Whittier Boulevard in the City of Los Angeles to Downey Road, about one mile east of the east city limits of Los Angeles, and continues southeasterly to Santa Ana.

The Aliso Street Grade Separation project carries this freeway traffic on a

continuation of the Santa Ana Parkway to Kearney Street and the necessary connections of Mission Road to both the Santa Ana Parkway and the Ramona Parkway will be completed at a later time, although temporary connections between Mission Road and the Ramona Parkway will be opened when the viaduct is put into use for vehicular travel on August 15, 1944.

COOPERATIVE PROJECT

The Aliso Street Grade Separation project, together with the traffic interchange at the easterly end thereof, has been handled under the direction of



This sketch of Aliso Street viaduct shows its connection with various important traffic arteries

the Santa Ana Parkway. Westerly of Main Street the extension of this parkway on State Highway Route 2, through the Civic Center to Hollywood is known as the Hollywood Parkway. Both of these parkways are freeways and are in the postwar program adopted by the California Highway Commission.

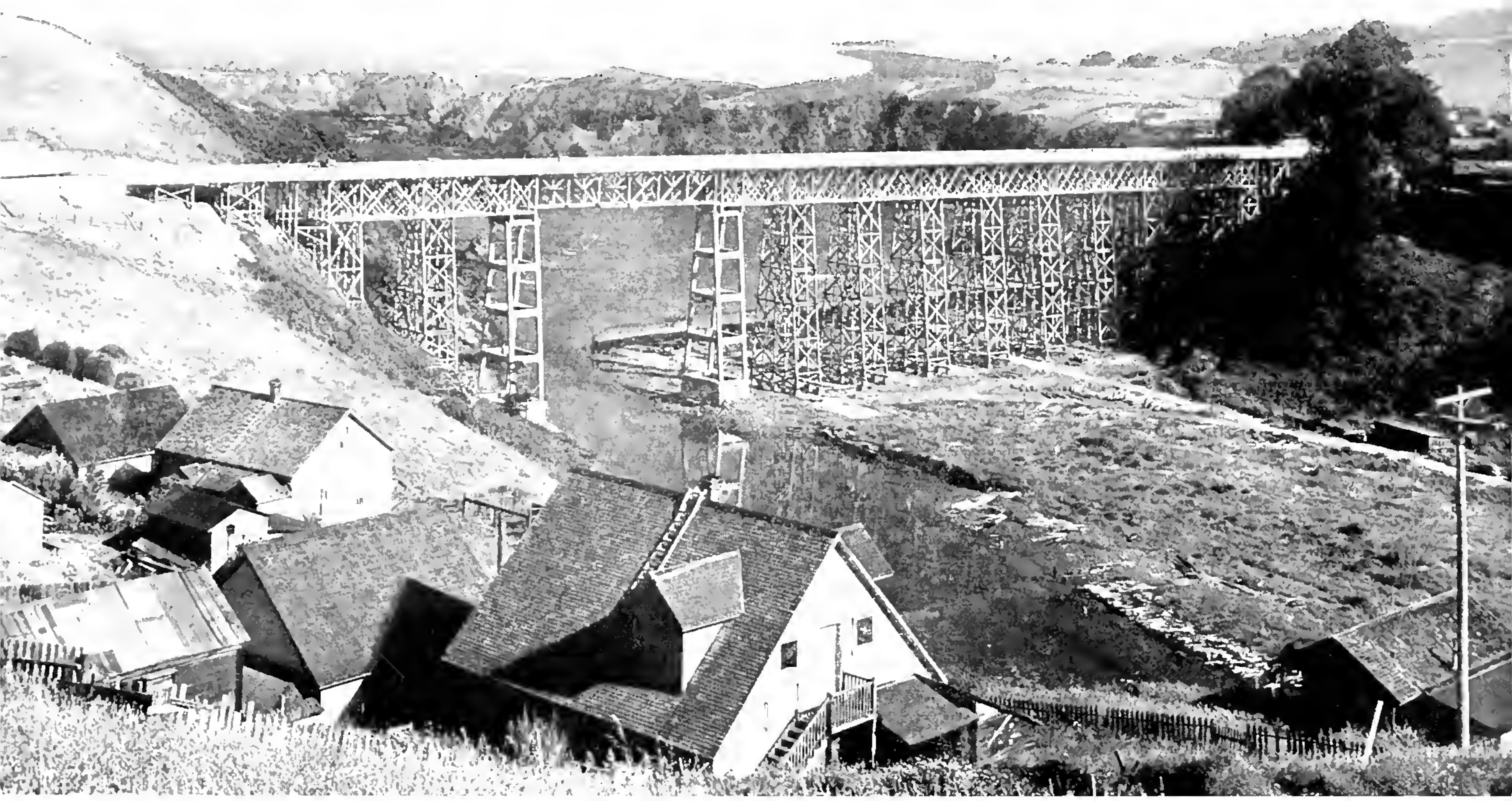
viaduct over the Los Angeles River, Mission Road and the major railroad lines on both banks of the Los Angeles River. The viaduct project starts at Vignes Street on the west and extends easterly to the Macy Street Bridge on the Ramona Parkway and to Kearney Street on the Santa Ana Parkway.

The interchange connection for the

the City Engineer of the City of Los Angeles. It is a cooperative project, much of which was done under a WPA project during the past three and one-half years and was jointly financed by the Pacific Electric Railway Company, the Santa Fe Railway Company, the Union Pacific Railroad Company, the Southern Pacific Railroad Company,

(Continued on page 17)

our High Sierra mountain passes were cleared of snow during June and opened to traffic. This is secti[illegible] of T[illegible]a Pass Highway between Ellery and Tioga Lake. Tioga Summit ele[illegible]on, 9,941 feet



View of new $350,000 Albion River bridge in Mendocino County. This is not the type of bridge the State would build under norma[l] conditions but steel for reinforced concrete and structural steel could not be secured and much salvaged material had to be use[d]

Highway Commission on Tour in Redwood Empire Dedicates New Albion Bridge

IN order to view at first hand proposed postwar highway projects in the Redwood Empire, the California State Highway Commission in mid-June made a three-day tour of inspection through Marin, Sonoma, Mendocino, Lake and Napa counties, stopping en route on Sunday, June 11th, to dedicate the new $350,000 Albion River Bridge at Albion in Mendocino County.

The commissioners, who were accompanied by State Highway Engineer George T. McCoy and members of his engineering staff, following breakfast in San Francisco, Saturday, June 10th, as guests of the Golden Gate Bridge and Highway District, went first to Sausalito, where they viewed the route of the projected Sausalito lateral. The group then proceeded to San Rafael for an inspection of the Linden Lane Underpass. At noon the State officials were luncheon guests of the Marin County Board of Supervisors, T. Fred Bagshaw, Chairman.

From San Rafael, the party traversed the Redwood Highway to the Sonoma County line and Black Point Cutoff, where it was joined by a delegation of Sonoma County officials. The commissioners were escorted to Sonoma, thence to Santa Rosa and from there to Sebastopol and Monte Rio via State Sign Route 12, returning in the afternoon to Sebastopol and traveling over the Gravenstein Highway to Cotati and thence to Petaluma.

Two contemplated projects wer[e] given attention in Petaluma, the pro[-]posed realignment of the Lakevill[e] Highway and the proposed truck high[-]way through the east side of the city via Highway 104 to the Redwood High[-]way on the north.

The commissioners were guests a[t] dinner at the New Hotel Petalum[a] sponsored by the Sonoma Count[y] Board of Supervisors where they wer[e] welcomed by George Kennedy, Chair[-]man of the Sonoma County Board o[f] Supervisors; Holly Vogensen, Presi[-]dent of the Associated Chambers o[f] Commerce; Mayor Jasper S. Woodson and other civic leaders of Petaluma.

The highway desires of Sonom[a] County, including improvements o[n]

U. S. 101 north through Cloverdale and a new highway to Bodega Bay to handle anticipated traffic expected there as a result of recent harbor improvements, were outlined by J. P. Kelly of Sebastopol.

Other speakers included Lyle Kirkpatrick, Chairman of the Lake County Board of Supervisors, and President of the Supervisors Unit of the Redwood Empire Association, who was in charge of the tour; Commissioner Harrison R. Baker of Pasadena, who said the commission is engaged in planning Governor Earl Warren's $80,000,000 postwar highway construction program; Commissioner James Guthrie of San Bernardino, who estimated it will require between $100,000,000 and $500,000,000 to bring the California highway system up to desired standards, and Charles H. Purcell, Director of Public Works and Chairman of the Commission, who said that the commission's program will assure benefits to the entire State.

Following breakfast in Petaluma Sunday morning, the commissioners and party were escorted by the Sonoma delegation to Cloverdale, where they were met by a welcoming party from Fort Bragg and escorted over the Cloverdale-to-the-Sea and Shoreline highways to Fort Bragg where they were tendered an abalone luncheon by the Mendocino County Board of Supervisors, Ed Haehl, Chairman, Sequoia Post No. 96, American Legion, and the Business Men's Club.

BRIDGE DEDICATED

Approximately 1,500 persons attended the dedicatory ceremonies at the Albion River Bridge, where Commission Chairman Purcell was the principal speaker. He was introduced by Commissioner Walter Sandelin of Ukiah, who summarized the rather unique history of the Albion span.

Participating in the dedication were Mrs. Marian A. Haarby, who has resided adjacent to the bridge since 1888, and her two sons, Martin and Albert. Mrs. Haarby, who is 87 years old, assisted in the ribbon cutting ceremonies. After the dedication exercises, the party motored along the Shoreline Highway to Rockport and Leggett Valley and then traveled south on the Redwood Highway to Willits where dinner was served in the American Legion hall, with the Mendocino County Board of Supervisors and Mendocino County Chamber of Commerce and the Willits Chamber of Commerce acting as hosts.

TOUR LAKE AND NAPA

Following the dinner, the party went to Ukiah for an overnight stop at the Palace Hotel, departing early Monday morning for Lake County. A delegation of Lake County officials met the commissioners at the south end of Blue Lake and escorted them to Upper Lake, thence on State Route 29 to Lucerne Cutoff, Clear Lake Highlands, Lower Lake and thence over Route 29 to Hoberg's Resort, where the Lake County Board of Supervisors was host at luncheon.

Leaving Hoberg's, the group went via Cobb to Middletown and on to Napa County, where it was welcomed at Calistoga by a delegation of Napa officials headed by Supervisor Tom Maxwell. During the afternoon, the

Section of crowd which attended the dedication ceremonies at the new Albion River bridge, showing speakers' platform in right foreground

Pioneer of Mendocino County, Mrs. Marian A. Haarby, severs hempen cord, signalizing opening to traffic of new Albion River bridge. Left to right, Highway Commissioners James Guthrie and Harrison R. Baker; Lyle Kirkpatrick, Chairman Lake County Board of Supervisors; Martin Haarby; C. H. Purcell, Director of Public Works and Chairman of the Highway Commission; Albert Haarby; Commissioners Homer P. Brown and Chester H. Warlow; State Highway Engineer George T. McCoy; Commissioner Walter Sandelin and Supervisor James Tocher of Lake County

commissioners visited St. Helena, the Beringer winery, Rutherford, and the Conn Canyon Dam project.

The tour concluded at Napa, where the commissioners and their party were guests of the Napa Board of Supervisors at dinner at the Napa Valley Inn. The highway officials left Napa Monday night for a commission meeting at Sacramento on Tuesday, June 13th.

Officials making the tour, which was arranged by Valerie Kuhn, Manager, and Ed Wilder, Publicity Director of the Redwood Empire Association, included C. H. Purcell, Chairman California Highway Commission and Director State Department of Public Works; Walter Sandelin of Ukiah, Highway Commissioner; Homer P. Brown of Diamond Springs, Highway Commissioner; Chester H. Warlow of Fresno, Highway Commissioner; Harrison R. Baker of Pasadena, Highway Commissioner; James Guthrie of San Bernardino, Highway Commissioner; G. T. McCoy, State Highway Engineer, State Department of Public Works; . H. Wilson, Office Engineer, State Department of Public Works; F. W. Panhorst, Bridge Engineer,

(Continued on page 20)

Ribbon Cutting Dates Back Centuries

RIBBON cutting ceremonies attendant upon the dedication of new highways and bridges have been greatly curtailed since the war began due to travel restrictions and the lack of new highway construction except for military roads. Doubtless these time-honored rites will be resumed when peace comes and the Division of Highways and the counties and cities of the State launch their huge postwar building program.

The question as to the origin and historical significance of the custom of cutting the ribbon stretched across a highway during the dedicatory ceremonies is one that is frequently asked.

This practice originated in England hundreds of years ago, even before the Magna Carta. English feudal lords and dukes received their lands from their sovereign and the original ownership was carried on down through the centuries. Quite frequently villagers whose homes adjoined these estates used pathways through the estates to go from one village to another or from one point to another and in time these pathways became accepted traveled routes although crossing privately-owned property.

Under old English law, if the free use of these pathways was not protested over a period of years, the pathways became legal public thoroughfares. In order to protect their property rights, the estate owners would each year or within a safe period of years, erect barriers or even stretch ribbons across the traveled pathways to indicate that they were not public lanes of travel. The villagers then would remove the barriers or cut the ribbon with the consent of the landowners and continue to use the pathways. On several of the larger estates for many years this practice of cutting the ribbon or removing the barrier became a ceremony participated in by the landowners and the villagers and in many cases developed into annual festivals.

(Continued on page 19)

Erosion Prevention on Highway Cut Slopes in San Diego County

By H. F. CATON, Resident Engineer

As the standards of highway alignment and profile have increased, it has become necessary to disturb the natural drainage by reason of the need for deeper cuts and higher fills to obtain desired results. This has resulted in the need for more erosion protection by means of artificial structures, as well as promotion of erosion retarding growth. Results by the latter method have been given considerable study in the last few years, and have proved not only financially profitable, by decreasing maintenance costs, but are yielding high returns in the development of aesthetic values.

Military needs dictated the moving of a portion of State Highway 199 in San Diego County and also the San Diego and Arizona Eastern Railway from a location through Coronado Heights to a lower position paralleling the San Diego Bay, and through a cut, approximately a mile in length with a 50-foot face.

RAINS ERODED CUT SLOPES

It was originally planned to develop erosion controlling growth by disking the face of the cut and spreading over it, approximately three inches of top soil, which had been salvaged and stockpiled. However, before the seed could sprout and mature, heavy seasonal rains occurred, which eroded the slopes to the extent that repairs were imperative. It also became evident that any seasonal rains supplying sufficient moisture to germinate the seed would cause erosion before the rooting of the plants could progress to the erosion preventative stage.

It was therefore decided that the work should be done during the season of little or no rainfall, when artificial or controlled watering could be used, and also that rye and barley seed should be added to the soil to give a rapid and uniform growth.

STRAW MULCH USED

To form a proper seed bed, it was decided to mulch the area with approximately four to five tons of straw per acre. These planting plans were worked out in conjunction with Land-

Untreated 2:1 slope after rain, showing result of erosion

Discing 2:1 cut slope prior to spreading top soil. Grader below is cabled to tractor above

Spreading straw over top soiled slope to provide a mulch scape Engineer Dana Bowers, from the Sacramento Headquarters Office.

Cuts were designed with a 2:1 slope which permitted the use of heavier equipment for a major part of the work. The surface was prepared for top soil by means of a 12-foot patrol and disk, operating horizontally on the cut face and held in position against side slipping by means of a tractor operating along the top of the slope

SOIL DUMPED OVER TOPS

The top soil was dumped over the tops of the cuts and worked down over the face by means of the same patrol and tractor. The preparation of the cut face by this method was both rapid and nominal in cost.

The work, to this stage, was set up as a part of the contract agreement, and accomplished by the contractor under contract unit prices. The balance of the work, involving erosion protection, was paid for as extra work under a contract change order.

Baled straw was purchased on the local market, distributed in approximately the right proportion along the tops of the slope and spread over the areas to be mulched, at the approximate rate of four to five tons per acre. The spreading was done by hand labor, using conventional hay forks. The flat slopes permitted labor to work over the areas without inconvenience.

SEED SPREAD OVER STRAW

Barley seed at the approximate rate of 1 pound per 200 square feet, and rye seed at the approximate rate of 1 pound per 170 square feet, were then spread over the loose straw, using a small manually operated one-man centrifugal seed spreader. Because a more rapid and heavy growth was desired, the seed was spread considerably heavier than for ordinary commercial crops.

With the seed and straw in place, several methods were attempted to properly mix the mulching straw with the top soil. These methods included a disk harrow, several types of tampers, and a crawler type tractor with extra deep grousers. None of the methods proved satisfactory until a single section sheepsfoot tamper, with a high frame was used. This method obtained results far in excess of any anticipated.

The sheepsfoot tamper was drawn back and forth on the face of the cut, parallel to the roadbed, by means of a tractor operated from the top of the fill, a patrol operated from the pavement, and the roller operating between the two by means of a cable bridle.

Punching in straw with sheepsfoot roller cabled between two tractors

Planting Ice Plant cuttings through straw along top and bottom of slope

Rye grass and barley crop growing through straw mulch

STRAW TAMPED INTO SOIL

All areas were covered by the tamper from two to three times, which sufficed to drive the straw to a depth of from three to six inches into the face of the cut. The above method of operating the sheepsfoot tamper horizontally on the face of the fill was possible because of the uniform height of the cut face and the fact that good operating surfaces for the tractor and

(Continued on page 19)

View of Ebbetts Pass Highway and Silver Mountain on east side of pass, the elevation of which is 8,800

Bridge Railing from Salvaged Railroad Rail

At the start of the present war, the Bridge Department of the Division of Highways purchased a large stock of old railroad rail to be used primarily for reinforcing in concrete structures as a war-time emergency. Most of this railroad rail was of 45-pound section and 30-foot lengths.

A great number of uses has been made of this rail besides using it as reinforcing. In one case, it was placed as a deck on the stringers of an old steel bridge. The space or gap between rails was filled with concrete. In other instances, it has been used as cattle-guards and gratings.

Its use as a bridge rail and wheel guard on the end of structures has helped in conserving materials now used in war construction. The appearance and practicability have more than proven its worth in all cases where it has been used.

A substitute, as a rule, is inferior to and less acceptable than the product for which it pinch-hits. However, this was not found to be true in the case of a substitute rail designed for the Poso Creek Bridge in Kern County between Woody and Isabella.

The old structure across Poso Creek was damaged beyond repair by flood waters, and it was necessary to prepare plans and build a new structure without the use of critical war materials. For a small structure located off of main arterial highways it is customary to use a standard redwood rail which has been developed and used for a large number of years because it has been found to give excellent service. Timber of any kind has become so critical during the war that a substitute railing to be built of noncritical materials, was considered to replace the timber rail design.

It was decided to substitute the railroad rail for the timber in the standard bridge guard railing.

Plans for the Poso Creek Bridge were, therefore, prepared based on the use of scrap railroad rail as a substitute material for the timber railing. The structure has now been completed and the accompanying pictures show that the new railing is pleasant in appearance, safe and sturdy, which is all that can be asked of any guard rail.

Use of railroad rail railing on Poso Creek Bridge

The type of bridge is not one which the State would design and build under normal conditions but is typical of the bridges which were built with available materials, such as could be found and salvaged, and not at the expense of critical materials. The construction of the bridge could not wait on account of the necessity of transporting critical materials, such as lumber, over the highway. Reinforcing steel for concrete and structural steel could not be secured. An old abandoned railroad truss was revamped to fit in for the mainspan and old railroad rails were used for reinforcing steel in the towers.

Although the type of bridge was not that desired a good serviceable structure was built which will serve the highway for many years to come.

This is another view of Poso Creek Bridge railing

Postwar Building Program Appears to be Financed Before Construction Begins

(Continued from page 1)

patient can go home. Generally most mental illnesses must be cured within their early stages or else the patient will in all likelihood, be a permanent or intermittent charge on the State the rest of his life. Around these and similar necessities the services for the State's sites are allocated, grouped and arranged to grow in parallel. In bulk, they will furnish each community with which they relate a substantial pool of material and construction employment as well as the discharge of an established State responsibility.

Mudjacking Experiments Develop Low Costs and Number of Improvements

By H. L. COOPER, District V Maintenance Engineer

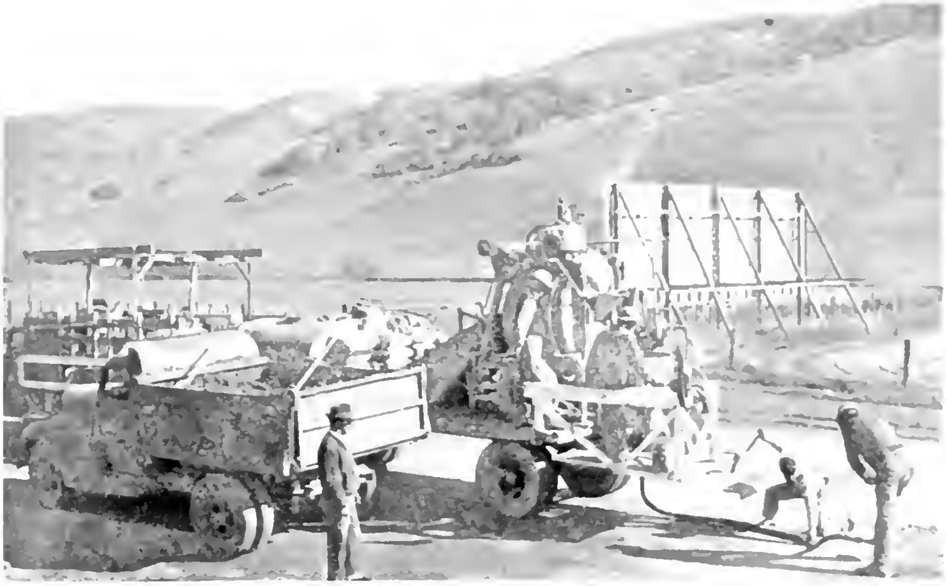
AN extensive mudjacking program has, for the past two years, been under way in District V, in an ffort to arrest the increasing number f step-offs in Portland cement conerete pavements at the joints and racks, occasioned by pumping action ollowing numerous repetitions of eavy wheel loads.

Some mudjacking was done during he 1943 season and the experience gained last year was of great value in lanning our work for 1944. Work orders in the total amount of $14,100 were authorized for this work at variaus locations from the Santa Clara County Line to the Ventura County Line on Route 2 (U. S. 101 Highway) on 12 different sections where the stepoffs were noticeable, particular attenion being paid to those sections where ight bituminous blankets were to be laced this summer either by contract or by day labor.

Work was started February 1st of his year at the north end of the disrict with drilling and mudjacking rews.

The drilling crew equipment consisted of a 370-cubic foot I. R. air compressor, one 3-cubic yard Chevrolet lump truck, two 60-pound hammers and one Ford pickup.

The mudjacking equipment consisted of Chevrolet utility paint truck with compressor, one 3-cubic yard lump truck for hauling mud, one 6-ton railer, one 1-sack concrete mixer, one 5-cubic foot mud container and one Chevrolet express.



Upper—Mud jacking equipment in operation. Forcing cement treated loam under paving.
Lower—Drilling holes preparatory to mud jacking operations

MATERIAL USED

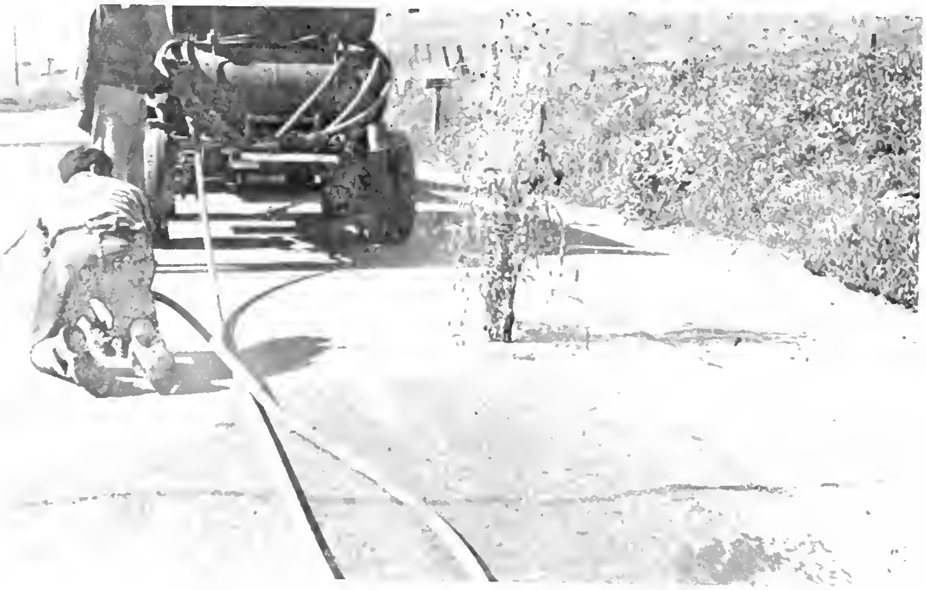
The material used at the beginning of the work was selected roadside material with the following screen analysis:

Screen	Per Cent Passing	
16	100	With a moisture equivalent 19.6 per cent and lineal shrinkage of 0.8 per cent
30	99	
50	76	
100	14	
200	6	
270	5	

The combined mud mixture consisted of: 1 cubic yard sand, 5 sacks cement, 100 pounds diatomaceous earth, 56 gallons water giving a combined weight of about 3,440 pounds. A total of 1,100 holes was filled with this material, but after the work progressed farther south, it was found that a better sand material could be purchased from a commercial plant at $1.20 per cubic yard which gave better results in the combined mix. This material had the following screen analysis.

Screen	Per Cent Passing
8	100
16	94
50	76
200	14-20

The combined mud mixture consisted of: 1 cubic yard sand, 5 sacks



This photograph shows water being forced from underneath pavement by air pressure

cement, 32 to 64 pounds diatomaceous earth, 92 to 116 gallons water and 50 to 100 pounds plaster of Paris, giving a combined weight of about 3,500 pounds.

TIME SAVED

Experimenting was done with this material to obtain a workable mix that would flow freely into the voids and have an initial set soon enough so that traffic passing over freshly filled areas would not force the mix out from under the pavement. The addition of the plaster of Paris set up the mix in 15 to 35 minutes, while before its addition, several hours to a day was required before a set was obtained.

It was found that in areas with small voids better results were obtained by increasing the diatomaceous earth content to 64 pounds per cubic yard and decreasing the plaster of Paris to 50 pounds which also increased the water content necessary to 116 gallons per cubic yard.

When large voids were encountered, 32 pounds diatomaceous earth and 100 pounds plaster of Paris were used which allowed traffic to move over these distressed areas in a very short time without any visible effect on mud content.

After moving to Santa Barbara County in the southern part of the district, the cost of trucking the entire amount of sand required from the commercial plant at Atascadero was so high that a commercial sand in Santa Barbara was mixed with the Atascadero sand on a 33⅓ to 50 per cent basis which gave satisfactory results.

ADDITIONAL EQUIPMENT

The addition for this year's work of a 6-ton trailer, 16 x 7 feet in size, was an important factor in more efficient operation as all of the mudjacking equipment was placed on this trailer, which acted as one unit. Two 300-gallon water tanks were placed on the front of this trailer, and a one-sack concrete mixer on the rear. Suspended from the extreme rear and slightly lower than the mixer, the 7-cubic foot mud pot was placed. The material, after being mixed, was poured into this pot, first being strained through a screen to remove lumps and foreign material. This mud container was converted from a sand container from a bridge sand blasting outfit and only one change was necessary—a 2-inch A. C. F. lubricator valve was placed at the exhaust end and a 1-inch heavy duty rubber hose 10 feet long was attached to this valve. The nozzle on the end of the hose was a piece of rubber hose, 6 inches long, with an outside diameter slightly less than the diameter of the drilled holes. When the nozzle was placed in the hole the pressure would swell the hose to a tight fit, allowing no escape of pressure or mud. A pressure of 80 pounds per square inch was found to be the most satisfactory at the compressor.

COST OF WORK

A total of 13,839 2-inch holes was drilled in 33 working days or an average of 419 holes drilled per day at a cost of \$0.20 per hole. The average drilling cost per day was \$82.59.

Mudjacking these 13,839 holes required 50 working days or a total of 276 holes filled per day at a cost of \$0.82 per hole. The average filling cost per day was \$227.50. For the entire work the cost of drilling and filling was \$1.02 per hole.

About 3.74 cubic yards of material was used per day and an average of 0.37 cubic foot material was forced into each hole, although there was a variation of from 0.1 cubic foot to 7.0 cubic feet per hole.

For the first portion of the work, two holes were drilled in each expansion and dummy joint per panel with no attempt made to raise the depressed slabs to grade. As the work progressed it was decided to raise the depressed slabs and the locations of the holes were changed to 6 inches to 12 inches away from the joints, two holes per panel and drilled 4 inches below bottom of pavement.

It was found that a larger amount of mud could be forced into each hole and the low slabs raised to grade fairly easily. The reason for this is probably due to the fact that where the crack filling material had become broken or was missing in the immediate area of the hole, pressure was lost through this opening and it was then impossible to force very much mud under the slab. Also in many cases the panels have the low areas at the joints and as the slabs are resting on the subgrade there are no voids to fill at this point.

Redwood pegs 3 x 3 x 10 inches with a sharpened end were used to plug adjacent holes when pressure was desired to lift depressed slabs. An examination after two weeks showed that these raised slabs were still at grade.

A chart on cross-section paper was kept showing the location of all holes, by station and distance in from edge and distance from joint, in order to determine at a later date the efficiency of this mudjacking after plant-mix blankets have been placed.

This entire mudjacking program was under the immediate direction of Maintenance Foreman E. C. Van Schaick who deserves full credit for the results obtained and for the various detailed experiments carried on in an effort to obtain the most efficient results.

Reconstruction of Highway Bridges Important Part of Postwar Program

By F. W. PANHORST, Bridge Engineer

THE reconstruction of highway bridges must be given serious consideration in any program of justifiable postwar construction. The reconstruction of many bridges is necessary to keep from having transportation bottlenecks scattered throughout the State Highway System.

There are numerous planning organizations throughout the country making various postwar plans. Most of the projects are proposed for furnishing employment to assist in taking care of the anticipated unemployment condition after the war. Public works furnish ideal projects to relieve the unemployment, but the necessity and justification of the projects considered should be carefully weighed.

Four types of bridges are dealt with in this article. This picture shows a modern bridge

Where do highway bridges fit in this picture? There are all kinds of bridges on the State Highway System, varying from those ready to fall down to those that are recent and of modern design. No two are alike in all conditions and the importance of their replacement varies accordingly. However, to keep the wheels rolling after the so-called "construction vacation" during the war, it is absolutely necessary that a certain number of these bridges be re-built and very desirable that many others also be constructed.

MODERN STANDARDS NEEDED

Many other bridges should be built to bring the Highway System up to modern standards of safety, width, etc. However, the so-called "bottleneck" bridges are so numerous and so much money is required that we will be fortunate if sufficient funds can be secured to do the necessary work without attempting to do the merely desirable work.

There are many stretches of highway now that legal size trucks cannot use on account of the below capacity bridges. Through the past few years, trucks and truck loads have increased in weight. These trucks are designed to carry the maximum legal load and if less load is carried, an uneconomical situation develops which increases the cost of transportation. The extra cost of transportation, which is caused by the necessary reduction in load on account of posted bridges, cannot be estimated but, undoubtedly, is far in excess of the money which would be required to remedy this undesirable and uneconomical situation.

This is type of bridge on which loads are not now restricted, but must soon be because of continued deterioration

DETERIORATION

Bridges deteriorate and wear out the same as people, buildings and other structures. Some people believe that concrete, steel and timber bridges and buildings are built to last forever, but nothing is completely enduring and even granite, the so-called "rock of ages" decomposes in time. Highway

A bridge in good condition but unable to carry legal load because of light design

bridges, however, do not deteriorate from age so much as the pounding action of heavy trucks. During this war period there has been a large amount of heavy hauling, and bridges which have stood up for years have recently deteriorated rapidly due to the pounding action of the heavy and frequent passages of highway loads necessitated by the war effort.

Highway Facts published in 1939, in connection with the State-wide planning survey gave the result of a study which indicated that with all the construction under way at that time, the State was falling behind at the rate of 38 bridges every year. In other words, we were not making progress, not even holding our own, but actually falling behind and losing ground. Since the beginning of war, there has been no new construction except in rare emergency situations, which would indicate that a bad situation is getting worse.

POSTWAR BRIDGES IMPORTANT

From the foregoing, it can be seen that the construction of highway bridges should have an important place in any postwar construction plans, not only to furnish labor to take care of an unemployment period but to keep traffic moving and to secure more economical transportation. Postwar projects constructed throughout the State will use materials which must be hauled over the highways and over these bridges.

Most people take bridges for granted—a bridge is a bridge, some perhaps more attractive than others, but if it has a good deck and a good looking rail it is a good bridge. Except in outstanding cases, even a trained bridge engineer cannot take one look at a bridge, and tell if the bridge can carry, with safety, the desired legal loads. There are no two bridges exactly alike, even if they may appear alike. They will have different carrying capacities and different lasting qualities.

During the war era, bridge repairs and replacements have been kept to an absolute minimum and done only as a dire emergency when necessary to keep traffic moving. Repairs had to be made which normally would not be considered economical since when repairs become excessive, it is more economical to reconstruct the bridge. However, with the shortage of supplies and critical materials, it was impossible to reconstruct many bridges which should have been reconstructed and they were shored up and repaired temporarily by ingenious and sometimes Rube Goldberg methods with the hope of holding the bridges together until such time as they could be rebuilt in an orderly and economical manner.

On any postwar program, the program of bridges should be based on a priority list, starting with the worst bridge from the standpoint of weakness and deterioration and working up the list as far as funds will permit. These bridges graduate in necessity from those which must be replaced or be barricaded up through the list of less important bridges to the bridges which should be replaced merely to bring them up to modern standards. To secure this result, all bridges are listed according to their priority of importance and a bridge reconstruction program outlined accordingly.

It is not easy or simple to figure the priority of a bridge since it includes many angles. It is not merely a question of the safe carrying capacity of a bridge or its posted limit. It includes the present carrying capacity of the bridge, its anticipated future life and carrying capacity, its location and the importance of the location, the type and frequency of loads, probable future highway improvements, the possibility of economical repairs or replacements, and many other conditions that must be considered and weighed. To arrive at the answer requires a combination of

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A "must" bridge which is weak and structurally unsound

Scene on Carson Pass Highway from Carson Spur to Twin Lakes. Carson Pass Summit elevation 8,650

New Type of Highway Signs Required to Save War Material

By MARTIN A. O'BRIEN, Maintenance Assistant

UPON our entry into the present World War, the Nation's supply of metals and other critical materials was required for military purposes. This restriction materially affected the road-signing activities of the Division of Highways.

In January of 1942, Thomas H. MacDonald, Commissioner of Public Roads Administration, requested the Division of Highways' cooperation in changing the specifications, to eliminate the use of metal, for highway signs. Shortly thereafter the War Production Board issued Limitation Order L-29, which made it mandatory to discontinue the use of metal for highway and other signs.

This division willingly cooperated with the request of Mr. MacDonald and the War Production Board's order and took immediate steps to determine the most suitable noncritical material that could be substituted for our porcelain enamel metal signs. We were aware that veneers and plywood sheets would make a satisfactory substitute for metal, but as they were also placed on the critical list, it was felt they should not be used for this purpose.

Numerous tests were made of various noncritical materials and, as a result, 3/16 inch tempered Masonite was selected. This material, while it has not proven a satisfactory substitute for metal signs, does work up easily and provides a good surface for baking enamel. It can be successfully drilled to hold reflector buttons and its selection made it possible to continue the use of reflectorized signs.

Since standard crystal reflector buttons also contained critical metals, they too were soon placed on the restricted list. The Signal Service Company of Elizabeth, New Jersey, then introduced a flat plastic reflector unit which is now substituted for reflectorized signs. These reflector units are of the rear-entry type, approximately the thickness of the sign face and are held in place by a backing made from Masonite.

The War Production Board's Limitation Order on metal signs made it necessary to revise the California Vehicle Code, which required metal in the stop, railroad crossing and speed limit signs. This was done at the regular session of the Legislature, in January, 1943, when the Vehicle Code was amended to permit the use of other than steel in these signs. The change was made retroactive so that all signs made from noncritical materials and erected within the State, now comply with all legal requirements.

Signs made from Masonite naturally do not have the strength of those made from metal and are more susceptible to damage through vandalism and other causes. Experiments have been made to reinforce these signs by placing 1 by 4 inch or 1 by 6 inch wooden strips on the sign backs.

Where old metal signs are available, they also are being used as backs to strengthen new signs. This metal backing has proven very satisfactory.

From the standpoint of maintenance, Masonite signs have proven unsatisfactory. The material is very brittle, hence easily broken, and even in case of minor damage, an entirely new sign is usually necessary.

As a war economy measure the Department has discontinued the erection of signs of a purely informational character such as those showing names of streams, historical landmarks, elevations, summits or fish hatcheries.

Since January 1, 1943, up to the present time, we have spent $28,355 for signs, or an annual expenditure of $20,125. This compares with an annual average expenditure prior to Pearl Harbor of $74,500 and a total expenditure for signs since 1925 of $716,655.

While installation of new highway signs is being held to a minimum, every effort is being made to maintain those now in place.

Then there is the man who prided himself on never being wrong. Accused of being wrong in a statement, he summoned his dignity, rose and said, "I want it understood that I never was wrong but once in my life, and that was when I thought I was wrong and wasn't."

Postwar Planning for Reconstruction of Bridges

(Continued from page 14)

theory, science, experience and judgment.

Studies have been made by the Bridge Department of the Division of Highways. In order to decide upon a reasonable priority list, one group of engineers of the Bridge Department is employed continuously in inspecting, posting, studying and classifying all bridges on the State Highway System. This crew consists of specialized engineers well trained and experienced in this type of work. Progressive or running records are kept of every bridge on the highway system.

There are approximately 4,300 bridges on the State Highway System that are regularly inspected. About 250 of them posted for less than legal load limit and another 750 carrying the legal limit with less than the normal safety factor.

FOUR CLASSIFICATIONS

Each bridge is really in a class of its own, on a graduated scale from worst to best, but in order to obtain an idea of the situation with regard to replacement, all the bridges may be roughly grouped in one of four classifications:

(1) First class, modern bridges
(2) Bridges in good condition but of light design and unsafe for legal loads
(3) Bridges now capable of carrying legal loads but replacement required in the near future due to deterioration
(4) The "must" bridges of light design, weak, and structurally unsound.

The first class needs little consideration and consists of the modern standard bridges which are of satisfactory width, clearance and can carry legal loads for a long time. Although about 75 per cent of the State Highway bridges are up to modern requirements as to structural strength, perhaps 25 per cent of these are too narrow for a modern highway or are on substandard alignment.

Some 10 or more bridges are in good condition and might last 10 to 20 years under existing conditions, but they are of such light design that they can not carry legal loads, and, therefore, should be replaced to keep from having bottlenecks on the highway. Unless conditions change, light loads can use these bridges with safety and maintenance costs will be reasonable for a few years at least. If sufficient funds could be secured these bridges should be replaced. We can not say we have an efficient highway as long as there are so many of these bridges forming weak links in otherwise first-class highways. These bridges may be likened to a lightweight fighter or wrestler in good trim but too light.

In the third class are a considerable number of bridges which at the present time can carry legal loads but have deteriorated to the point where their economic life is practically over, maintenance costs are increasing rapidly and posting is imminent. These bridges may be compared to a heavyweight wrestler or prize fighter who is winded or just about ready for forced retirement. Just a year or two separate bridges in Class 3 from some 40 or 50 bridges in Class 4 which might be called the "must" bridges. These are posted bridges structurally weak and in such a condition that further repairs are uneconomical. When your private car requires extensive and continuous repairs, and even then can not regain its former power or speed, it is replaced. The same is true with bridges, especially those in this class. The bridges in this class must be replaced, postwar or no postwar program if a definite and distinct loss to traffic and value of adjacent highways is to be prevented. It should be remembered that from 6 months to 2 years is likely to elapse between the budgeting of funds and completion of construction of a new bridge in normal times and the existing bridge may get much weaker in that time.

There is the usual obstacle in the way of correcting the undesirable situation outlined above—funds. How much money will be required? How much can be secured? The picture is changing constantly but a rough idea of the magnitude of the cost may be obtained. Considering Class 3 bridges to be those not posted but needing replacement within about 5 years time and all Class 4 bridges, the total cost of replacing these bridges alone being estimated at around $14,000,000. This includes no bridges with narrow roadways, bad alignment or even posted if they can be made to serve at reasonable cost for the 5 years. It does not include the cost of highway reconstruction that often is considered necessary in order to avoid building a new bridge off its final alignment. It does not include anything for emergency reconstruction as the result of fire, flood or abnormal traffic. To bring all bridges up to modern standards, taking into account all of the above factors, it has been estimated that around $70,000,000 will be required.

In addition to all this, millions must be spent for bridges, grade separation projects, overheads, subways, and other structures required by new highways which must be built to take care of even the past normal increases in traffic which should at least be equalled as soon as the country settles down to a peaceful existence once more.

Plans for a large number of bridges that must be built are under way and many plans have been completed. They are now filed ready to be advertised immediately when the proper time arrives.

Ramona and Santa Ana Parkways Proposed for Los Angeles Area

(Continued from page 2)

the City of Los Angeles, the County of Los Angeles, the Federal Government, and the State Division of Highways. The total cost of the viaduct project was about $5,000,000.

The Pacific Electric railway tracks were placed and put into operation over this new viaduct between Vignes Street and the Pacific Electric's private right of way at Macy Street on July 21, 1943. The interchange connection between the Santa Ana Parkway and the Ramona Parkway at the easterly end of the bridge will be completed and the project opened to traffic on August 15, 1944.

OPERATION OF TRAFFIC

The operation of traffic at this connection can be more easily understood by examining the accompanying perspective sketch. It will be seen that Aliso Street, which connects with the Civic Center of Los Angeles, is carried on a viaduct over the Los Angeles River and the tracks of the Southern Pacific, Santa Fe and Union Pacific on each side of the river.

The viaduct also carries through traffic over Mission Road. A suitable ramp will permit local traffic to leave Aliso Street on the right and enter Mission Road and other streets in the vicinity. Another ramp will bear to the right for outbound traffic to enter the Santa Ana Parkway. Inbound traffic from Santa Ana Parkway will pass under the outbound Ramona Parkway Branch and connect with Aliso Street on an inbound ramp. Similarly, northbound Santa Ana Parkway traffic can turn eastward onto Ramona Parkway and both inbound and outbound Ramona Parkway traffic will have access to the Aliso Street viaduct without having to cross traffic from any of the other connections.

CONVERSION OF BOULEVARD

The new Ramona Parkway between Aliso Street and the east boundary of Los Angeles City at Indiana Street is actually the conversion of a portion of the Ramona Boulevard improvement completed in 1935 into a modern freeway utilizing the old pavement as much as possible in the new improvement. Existing bridges at Macy, Lord, State, Cornwall, Pomeroy, Marengo, Soto and Fickett streets over the present Ramona Boulevard pavement have been extended as necessary to permit this highway to be brought up to freeway standards.

The new Ramona Parkway consists of two 35-foot roadways with three lanes of traffic in each direction, separated by a raised curb dividing strip four feet wide. Suitable inlet and outlet ramps for traffic interchange are provided at Pomeroy Street and Fickett Street. The cost to the State for the construction and right of way between Macy Street and the east city limits of Los Angeles at Indiana Street, 1.95 miles, is approximately $1,208,000. This includes the original cost of improving Ramona Boulevard as a highway and the cost of converting it to a freeway.

The above described work will provide a section of modern, safe freeway for the rapidly growing traffic in this portion of the metropolitan area for a distance of 2.5 miles, from Vignes Street to the east city limits of Los Angeles, which freeway facilities will be extended in both directions as funds become available.

Highway Bids and Contract Awards for June and July 1944

Bids and Awards for June 1944

BUTTE COUNTY—Between Nelson and 1½ miles north of Durham, about 7.7 miles to be repaired with plant-mixed surfacing on existing roadbed, with crusher run base on imported borrow, and seal coat to be applied to existing surfacing, new plant mixed surfacing and new crusher run base. District III, Route 3, Section C. J. R. Reeves, Sacramento, $96,212; M. J. B. Construction Co., Stockton, $111,162. Contract awarded to Piazza & Huntley, San Jose, $94,780.

BUTTE COUNTY—Between junction of Route 87 and Oroville Airport about 2.4 miles to be repaired with plant-mixed material. District III, Route 21, Section A. Contract awarded to Lester L. Rice, Marysville, $10,691.

CONTRA COSTA COUNTY—Between Broadway Tunnel & Orinda Junction, about 1.8 miles to be repaired by placing asphalt concrete on the existing roadbed. District IV, Route 75, Section A. A. J. Raisch, San Jose, $41,910; Gallagher & Burk, Oakland, $40,070; Chas. L. Harney, San Francisco, $43,270; Louis Biasotti & Son, Stockton, $43,372; Lee J. Immel, Berkeley, $43,660; Independent Construction Co., Ltd., Oakland, $44,300. Contract awarded to Union Paving Co., San Francisco, $34,827.

HUMBOLDT COUNTY—Between the junction with Route 85 and Blue Lake about 5.1 miles to be repaired with plant-mixed material and seal coat. District I, Route 20, Section A. Clements & Co., Hayward, $49,405. Contract awarded to Mercer Fraser Company, Eureka, $44,755.

HUMBOLDT COUNTY—Across Willow Creek and East Branch of Willow Creek between 32 and 36 miles east of Arcata, a reinforced concrete box culvert and a timber trestle bridge to be constructed. District I, Route 20, Section C. Wm. E. Thomas Concrete Construction, Petaluma, $22,672; O'Connor Bros., Red Bluff, $23,955; Mercer Fraser Company, Eureka, $24,311. Contract awarded to Kiss Crane Co., San Pablo, $17,710.

LASSEN, MODOC AND SISKIYOU COUNTIES—Between Constantia and Oregon State line, about 34.8 miles to be repaired by applying a seal coat. District II, Routes 29, 73, 210. A. A. Tieslau & Son, Berkeley, $23,420. Contract awarded to Harms Bros., Sacramento, $22,950.

LOS ANGELES COUNTY—In the city of El Segundo on Douglas St. between Imperial Highway and 1100 feet south, about 0.3 mile to be graded, paved with Portland cement concrete and surfaced with plant mixed surfacing. District VII, Griffith Co., Los Angeles, $29,262; Oswald Bros., Los Angeles, $31,518; Dimmitt & Taylor, Los Angeles, $32,602; Western Dredging and Construction Co., Los Angeles, $36,723; Bonadiman McCain, Inc., Los Angeles, $40,918. Contract awarded to Olympic Contracting Co., Los Angeles, $28,977.

LOS ANGELES COUNTY—Between Monrovia and La Verne, portions only, about 2.6 miles to be repaired with plant mixed material. District VII, Route 9. Griffith Co., Los Angeles, $16,324; Vido Kovacevich, South Gate, $17,315; W. E. Hall Co., Alhambra, $17,677. Contract awarded to Pacific Rock & Gravel Co., Los Angeles, $16,313.

LOS ANGELES COUNTY—On Figueroa St. between Anaheim St. & B St. and on C St., between Hawaiian Ave. and Figueroa St., [illegible] 0.7 mile to be graded and surfaced with [illegible] mixed surfacing and Portland cement [illegible]. District VII, Route 165 and C S[illegible]. Dimmitt & Taylor, Los Angeles, $42,6[illegible]. Contract awarded to Griffith Co., Los Ang[illegible], $36,133.

MADER[illegible] COUNTY—Between 7.8 and 11.9 miles n[illegible] of Madera, about 11 miles to be repaire[illegible] with plant mixed surfacing. District VI, Ro[illegible] 4, Sections B, C. M. J. Ruddy & Son, Modesto, $28,480. Contract awarded to Stewart & Nuss, Inc., Fresno, $17,855.

MARIN AND SONOMA COUNTIES—Between Ignacio and Sears Point, about 3.5 miles, a seal coat to be applied. District IV, Route 8, Sections A, A. A. A. Tieslau & Son, Berkeley, $2,321; Lee J. Immel, Berkeley, $3,235. Contract awarded to A. G. Raisch, San Francisco, $2,242.

MARIN SONOMA COUNTIES—Between Petaluma and San Rafael, portions about 2.4 miles in length, to be repaired with plant-mixed surfacing. District IV, Route 1, Sections C, A. Lee J. Immel, Berkeley, $29,735; Louis Biasotti & Son, Stockton, $31,129; E. A. Forde, San Anselmo, $36,010; Chas. L. Harney, San Francisco, $36,103. Contract awarded to A. G. Raisch, San Francisco, $27,490.

MENDOCINO COUNTY—Between Navarro River and Caspar, about 3.9 miles to be repaired by furnishing and placing imported base material on portions of the project and applying seal coat to new base and existing surfacing. District I, Route 56, Sections D, E. Close Building Supply, Hayward, $38,940; Elmer J. Warner & Ted Watkins, Stockton, $39,135; A. A. Tieslau & Son, Berkeley, $40,915. Contract awarded to A. Teichert & Co., Sacramento, $35,541.

ORANGE COUNTY—Trabuco Road between Route 2 and Marine Base, and Central Avenue between Route 2 and Trabuco Road, about 4 miles to be graded and surfaced with plant-mixed surfacing on untreated rock base and plant mixed surfacing to be placed on the existing surfacing. District VII. Arthur A. Johnson, Laguna Beach, $82,652; Griffith Co., Los Angeles, $82,821; Lewis Construction Co., Los Angeles, $84,584; Sully Miller Contracting Co., Long Beach, $86,088; J. E. Haddock Ltd., Pasadena, $89,041; M. W. Stanfield Co., Los Angeles, $89,816. Contract awarded to W. E. Hall Co., Alhambra, $77,871.

ORANGE COUNTY—Between San Diego County line and Doheny Park, portions only, about 4.4 miles, to be repaired with plant-mixed material, imported borrow and bituminous surface treatment. District VII, Route 2. Arthur A. Johnson, Laguna Beach, $66,325; W. E. Hall Co., Alhambra, $69,878; Oswald Bros., Los Angeles, $73,670; J. E. Haddock, Ltd., Pasadena, $75,532; Griffith Co., Los Angeles, $77,455; Pacific Rock & Gravel Co., Los Angeles, $78,875. Contract awarded to Sully-Miller Contracting Co., Long Beach, $66,155.

SACRAMENTO COUNTY—Between McConnell and Sacramento, portions only, about 8.3 miles to be repaired with plant mixed material. District III, Route 4, Section B. McGillivray Construction Co., Sacramento, $47,680; Louis Biasotti & Son, Stockton, $57,480; Westbrook & Bing, Sacramento, $60,100; M. J. B. Construction Co., Stockton, $69,200. Contract awarded to A. Teichert & Co., Sacramento, $47,520.

SAN BERNARDINO COUNTY—Plant-mixed surfacing and seal coat to be placed between Verdemont and Devore, about .5 mile, and between Sycamore Avenue and Cajon Creek, about .9 mile. District VIII, Routes 31,190, Sections A, B. Contract awarded to Geo. Herz & Co., San Bernardino, $12,676.

SAN DIEGO COUNTY—Between Escondido and north county line, and between 6 miles east of Oceanside and Route 77, portions only, about 7.8 miles to be repaired with plant mixed material. District XI, Routes 77 and 195, Sections CDE, A. Schroeder & Co., Inc., Roscoe, $54,575. Contract awarded to Southwest Paving Co., Roscoe, $50,045.

SONOMA AND MARIN COUNTIES—Between Petaluma and San Rafael, portions about 2.4 miles in length to be repaired with plant mixed surfacing. District IV, Route 1, Sections C, A. Lee J. Immel, Berkeley, $29,735; Louis Biasotti & Son, Stockton, $31,129; E. A. Forde, San Anselmo, $36,010; Chas. L. Harney, San Francisco, $36,103. Contract awarded to A. G. Raisch, San Francisco, $27,490.

TULARE COUNTY—Between Goshen Underpass and 3 miles northerly, about 2.6 miles to be repaired with imported borrow, untreated rock base and plant-mixed material with seal coat. District VI, Route 4, Section F. Contract awarded to Brown, Doko & Baun, Pismo Beach, $62,725.

VENTURA COUNTY—Between Oxnard and Camarillo, portions only, about 7.2 miles to be repaired with plant mixed material and imported borrow. District VII, Route 153. Griffith Co., Los Angeles, $71,441; Schroeder & Co., Inc., Roscoe, $76,561; Dimmitt & Taylor, Los Angeles, $83,780. Contract awarded to R. R. Hensler, Glendale, $66,675.

YOLO, SACRAMENTO, EL DORADO, PLACER AND NEVADA COUNTIES—At various locations, about 56.7 miles to be repaired by applying a seal coat. District III. A. A. Tieslau & Son, Berkeley, $40,460; W. C. Railing, Redwood City, $48,853; Close Building Supply, Hayward, $51,796. Contract awarded to J. P. Breen, Sacramento, $35,412.

Bids and Awards for July 1944

ALAMEDA COUNTY—In the city of Oakland on Sequoyah Road, between Oak Knoll Blvd. and San Leandro Naval Hospital, about 0.9 mile, to be graded, paved with Portland cent concrete pavement and surfaced with plant-mixed surfacing on waterbound macadam base. District IV. Independent Construction Co. Ltd., Oakland, $62,429; Fredrickson Bros., Emeryville, $63,065; MacDonald & Kahn, Inc., San Francisco, $65,245; Lee J. Immel, Berkeley, $68,991. Contract awarded to Heafey-Moore Co., Oakland, $59,476.

BUTTE COUNTY—Portions between Biggs Road and Oroville Wye, about 4.6 miles to be repaired with plant-mixed material. District III, Route 3, Section B. Westbrook & Bing, Sacramento, $39,865; Lester L. Rice, Marysville, $47,060. Contract awarded to Piazza & Huntley, San Jose, $36,875.

CONTRA COSTA COUNTY—A drainage pipe and drainage improvements to be installed one mile east of Orinda Junction. District IV, Route 75, Section A. M. J. McGuire & M. Hester, Oakland, $13,216; Peter Sorensen, Redwood City, $13,976; Lee J. Immel, Berkeley, $17,330; James H. McFarland, San Francisco, $20,266. Contract awarded to A. A. Tieslau & Son, Berkeley, $10,891.

CONTRA COSTA & ALAMEDA COUNTIES—Between Willow Pass and Dublin, portions about 8.2 miles to be repaired by surfacing with plant-mixed surfacing. District IV, Routes 75,107, Sections B,B. Union Paving Co., San Francisco, $59,668; W. P. Railing, Redwood City, $65,132; Chas. L. Harney, San Francisco, $68,849; M. J. Ruddy & Son, Modesto, $70,362; Lee J. Immel, Berkeley, $73,723. Contract awarded to A. J. Raisch, San Jose, $58,311.

LOS ANGELES AND ORANGE COUNTIES—Carson Street between Route 168 and Orange County line and Garden Grove Avenue between Route 170 and Santa Ana, about 9.6 miles to be repaired with plant mixed material. District VII, Routes 178 and 179, Sections A,A. W. E. Hall Co., Alhambra, $51,122; Griffith Co., Los Angeles, $55,460; Oswald Bros., Los Angeles, $59,484. Contract awarded to Sully-Miller Contracting Co., Long Beach, $44,657.

MONTEREY COUNTY—Between San Ardo and King City, portions only, about 8.5 miles to be repaired by removing existing bituminous surfacing and placing it on shoulders, furnishing and placing imported borrow and crusher run base and applying nour coat. District X, Route 2, Sections [illegible] M. J. Ruddy & Son, Modesto, $192 [illegible]; Frederickson Bros., Emeryville, $228 [illegible]; Arthur A. Johnson, Laguna Beach [illegible] $23,961. Contract awarded to [illegible] Construction Co., Watsonville, $182,455.

NAPA COUNTY—Between Napa and [illegible]ntville, about 2.6 miles, to be repaired by [illegible]facing with plant-mixed material. District [illegible], Route 49, Section B. A. G. Raisch Co., [illegible]n Francisco, $19,015; A. S. Jones, Napa, [illegible],230; C. M. Syar, Vallejo, $20,177; Lee J. [illegible]mel, Berkeley, $20,537; W. C. R[illegible], [illegible]dwood City, $21,010. Contract awarded to [illegible] A. Forde, San Anselmo, $18,881.

SACRAMENTO, PLACER, YOLO [COU]NTIES—Between Salvia School and [Ro]seville, between Hood and Sacramento, and [bet]ween Knesel and Sacramento, about [illegible] [mi]les to be repaired with plant-mixed surfa[ce] [illegible]. District III, Routes 3, 11, 50. A. [Te]ichert & Co., Sacramento, $31,551. Con[tra]ct awarded to McGillivray Construction [Co.], Sacramento, $27,788.

SAN BERNARDINO COUNTY—Be[tw]een Cajon Summit and Victorville and [bet]ween Daggett and Needles, 62.8 miles to be [rep]aired by placing seal coat over the existing [sur]facing. District VIII, Routes 31, 58. [Fo]ntier Construction Co., Whittier, $71,140; [illegible]nnell Co., Alhambra, $71,770; Geo. Herz & [Co.], San Bernardino, $73,906. Contract [aw]arded to R. R. Hensler, Glendale, $57,175.

[C]eremony of Ribbon [C]utting Dates Back [S]everal Centuries

[Continued from page [illegible]]

California has a law based on the ol[d] [E]nglish custom and law which pro[vi]des that where a section of privately-[o]wned land is used by the public for [tr]avel unrestricted for a period of [fi]ve years, that section of property, [w]hether it be a lane, short cut, or a [p]athway, becomes public property.

The significance of our highway rib[b]on ceremonies is that the State, hav[in]g acquired new rights of way for a [n]ew highway, stretches a ribbon across [th]e project when completed and ready [f]or opening to traffic, then by the m[e]re [a]ct of cutting the ribbon serves notice [th]at henceforth this road is a free [tr]aveled highway.

The railroads, particularly, are care[fu]l on their extensive rights of way to [m]aintain at all times NO TRESPASS [si]gns in order that usage of any part [o]f their right of way by the public over [a] period of five years or more will not [e]ndanger their ownership.

There have been occasions in Cali[f]ornia where ranch owners neglected [t]o protect their property rights, per[m]itting public usage of their lands [a]nd lost that portion of them used by [t]he public under the State law.

We understand that a fireman in a small [t]own recently by accident drank some fire [e]xtinguishing fluid, and boy! was he put out!

Gas Tax to Cities Not to be Based On Snap Censuses

IN [illegible] Director of Public Works C. H. Purcell by the Attorney General [illegible] California cities [illegible] the [illegible] gas tax [illegible] beginning [illegible] Division of Highways will be based upon the decennial census of 1940 except as modified by some 20 special censuses which have been taken in compliance with the requirements of Chapter 581 of the Statutes of 1943, which the U. S. Bureau of Census [illegible] have been certified to the Department of Public Works.

Purcell said that the [illegible] is that dictated by the Attorney General, who holds that [illegible] or spot check censuses are not the type of census contemplated by the Legislature of 1943 when it amended the law governing the distribution of [illegible] gas tax funds [illegible] during the war.

These valid California cities [illegible] special censuses taken by Bureau of Census at the expense of each city. Several sample population counts have been taken chiefly for the purpose of allocation of foodstuffs, needs for housing, schools, transportation [illegible] hospitalization, public utilities, day care for workers' children and similar problems arising in congested areas.

Approximately 50 California cities [illegible] the Bureau of Census on the basis of sample censuses a certificate of [illegible] population for the purposes set forth in Chapter 581, Statutes of 1943. The Director of Census [illegible] 45 [illegible].

"[illegible] June 21, 1944 [illegible] Attorney General [illegible] Director of Census [illegible] of population [illegible] the Legislature [illegible] Wartime [illegible] Chapter 581 [illegible] special census taken [illegible]

Erosion Prevention in San Diego County

[illegible]

SAN DIEGO [illegible]

A [illegible] Water was [illegible] Seven inch [illegible] slopes [illegible] the appropriate [illegible] treated slope [illegible] parallel [illegible] about 500 feet [illegible] down drains were constructed, leading into existing drainage culverts.

[illegible]

Highway Commission on Tour in Redwood Empire Dedicates New Albion Bridge

(Continued from page 6)

State Department of Public Works; Colonel John H. Skeggs, District Engineer, District No. 4, Division of Highways, San Francisco; A. M. Nash, District Engineer, District No. 1, Division of Highways, Eureka; George N. Cook, Assistant Secretary, California Highway Commission; D. V. Nickerson, State Photographer, Sacramento.

The Albion Bridge was taken into the State Highway System by legislative act in August, 1933, after which time the State became directly interested in its condition, strength, carrying capacity, safety, etc.

The bridge consists of 10 timber spans of 18 feet, one span of 15 feet and three timber truss spans of 108 feet each, with an overall length of 521 feet. The roadway width was 16 feet with no wheel guards. The bridge was inspected in 1933 after being adopted by the State and the condition was found to be good but of light design, which necessitated posting for 11 tons and 15 miles per hour. As a safety measure, wheel guards were added, which reduced the roadway width to 14.6 feet. Later the bridge was redecked and widened to 16 feet 9 inches between wheel guards.

The bridge was inspected periodically as all other State bridges are and repaired from time to time. In the August, 1941, report, it is noted that many heavy loads used the bridge, greater than legal loads, while posted for limited loads, and it was noticed that there was a big sag in the trusses—a danger sign for timber trusses. In February, 1942, the overloads were continuing and repairs were made in an attempt to hold the bridge together.

Since the time was rapidly approaching when it would be necessary to close the bridge to truck traffic, governmental approval was requested to build a new bridge. On April 21, 1942, the Board of Review of the War Production Board considered the bridge "not sufficiently important." The State would not take "no" for an answer on account of the importance of the project and every effort was made to secure approval of the project. Letters of assistance were written by local lumber companies, supervisors, etc., and the application made to the government June 5, 1942, was approved by the War Production Board for construction June 16, 1942.

The contract for a new bridge was advertised August 28, 1942, and the contract with Maurer and Son approved October 5, 1942, the time for completion being June 5, 1943—a little over a year ago. The contractor would have completed the bridge within the time limit except for the various delays encountered.

Priority ratings required for materials kept going up and up and construction was delayed at the beginning for lack of materials. A higher priority rating was requested with no results. After continual efforts through December, 1942, and January, 1943, a higher rating finally was granted in February, 1943, but at this time lumber could not be secured.

Then, to further complicate matters, the WPB put a "stop order" on the job March 31, 1943, and this was reaffirmed by the Facilities Review Committee April 27, 1943. All work was stopped on April 13, 1943, and protests sent to the WPB. Wires were sent to Congressman Lea, the Commissioner of Public Roads and the Works Progress Administration, with supporting wires from lumber companies, Redwood Empire Association, county supervisors and other local organizations.

In May, 1943, a very thorough investigation was made and the members of the old bridge were bored carefully to determine the extent of decay. It was found that the condition of the bridge was even worse than anticipated. Authority to resume new construction work was received June 16, 1943.

Revised application for materials was made June 16, 1943, but it was found impossible to secure redwood lumber. In order to keep the work going, a change to salt treated fir was approved by the Public Roads Administration June 21, 1943.

Work was resumed July 5, 1943, and a preference rating AA-1 received July 16, 1943. After many additional trials and tribulations caused by material, labor and equipment conditions work progressed to the point achieved when the bridge was ready to receive traffic.

Gas Tax Revenues Show an Alarming Tendency Downward

THE State Board of Equalizatio in June announced completio of California gasoline tax asses ments for April amounting to $4,025 417 in contrast to $3,871,866 for th same month a year ago.

This is the smallest gain registere for any month of 1944 over the corres ponding tax for 1943. George F Reilly, member of the board, said tha it is indicative of a **sharp downwar trend in the tax yield.** Contrastin gasoline tax collections, he pointe out:

"April taxes on distribution of 134, 180,555 gallons were only 153,551, o 3.97 per cent over those of a year ago March taxes were correspondingl greater by 260,261, or 6.76 per cen while those for February were 503, 255, or 15.1 per cent higher. In Janu ary the gain was 636,051, or 19.26 pe cent.

"If we compare collections for Apri of this year with those of 1942, th drop is even more marked. Two year ago April taxes were $4,574,371. Th full force of this comparison is real ized when it is recalled that in 1941 the last year before rationing, th April collections were $5,452,587."

Reilly expressed the belief that thi trend is inevitable due to the in creased tempo of the war with its at tendant curtailment of gasoline sup plies for local consumption. He warned that it would mean a definite lessening of funds for highway work and that the people of this State must be prepared for postponement of projects dependent on gasoline taxes for their support.

Gasoline rationing has reduced gasoline tax revenues by approxi mately $50,000 a day. Gasoline tax assessments for May totaled $4,154,032 a drop of $19,664 under that of May 1943, and $1,469,741 under that of May, 1941, the last year before rationing.

The May tax revenues were based on a distribution of 138,467,748 gallons. This was 1,654,797 less than for May, 1943.

Teacher: Why, Junior, you say you wouldn't like to be President?

Junior: Not just now. If it's all the same to you, I'd rather wait until a couple more elections and things cool down a little.

State of California

EARL WARREN, Governor

Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

CHARLES H. PURCELL, Director of Public Works

A. H. HENDERSON, Assistant Director

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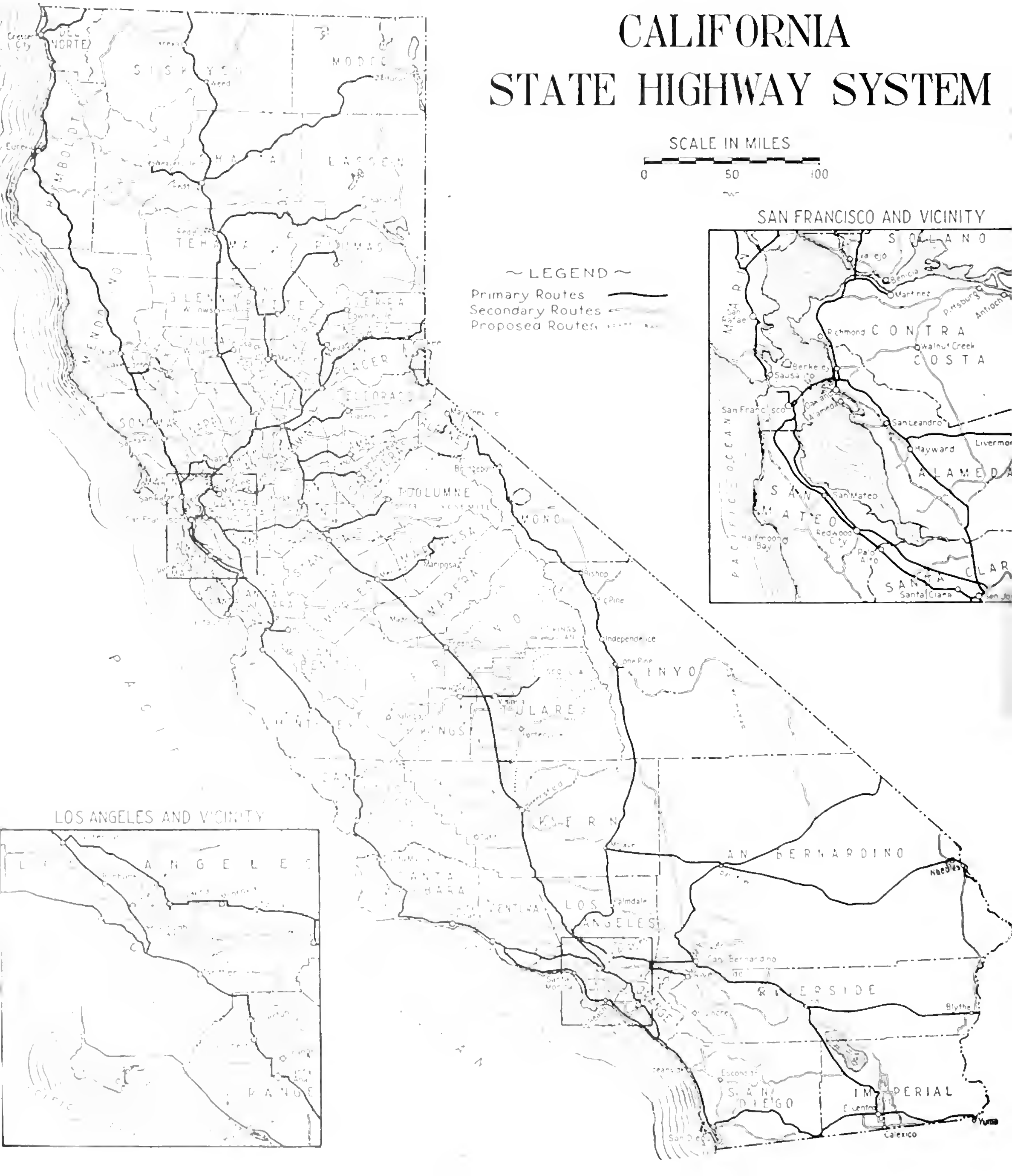

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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California Highway Commission Gives Help to San Francisco On Postwar Airport Project

NEGOTIATIONS between the City of San Francisco and the California Highway Commission on the relocation of the Bayshore Freeway, U. S. Highway 101 BY-PASS, in the vicinity of the San Francisco Municipal Airport, were climaxed on September 21st when a mutually satisfactory agreement opening the way for postwar development of the airport was reached by the city and the State.

The commission, meeting in San Francisco, adopted a resolution agreeing to relocate a portion of the Bayshore Highway near the airport, to relinquish title to its present right of way through airport property and binding San Francisco to an agreement to "construct a facility equal and equivalent to the standard of the existing road," and to build the additional length of freeway which will be required by the shifting of the present highway to the western boundaries of existing airport property. The additional length will be between 1,400 and 2,000 feet.

The resolution was approved by the San Francisco Public Utilities Commission on September 25th.

It had been the plan of the Highway Commission to develop the Bayshore Freeway along its present location through airport properties. The Public Utilities Commission, however, desired to extend the airport both east and west by "stage construction" and felt that a freeway through the middle of the field would hamper development.

The formula for the agreement was reached when the city offered to pay the additional expenses involved in relocation of the freeway along the western boundaries of the airport. The present highway bisects the airport with 2,450 acres on one side of the roadway and 550 acres on the other. Shifting of the freeway to the west will permit the consolidation of the 2,900 acres of airport land into one large field.

Headed by their chairman, C. H. Purcell, who is also Director of Public Works; State Highway Engineer George T. McCoy, and Assistant State Highway Engineer Fred Grumm, the Highway Commissioners inspected the airport properties and the proposed relocation site on September 20th. They were accompanied by Mayor Lapham; Marshall Dill, President of the Public Utilities Commission; E. G. Cahill, Manager of Utilities; Chief Administrative Officer T. A. Brooks, and B. M. Doolin, Airport Manager, representing the City of San Francisco.

In a statement commenting upon the agreement, Mr. Cahill said:

"The sympathetic hearing accorded the San Francisco delegation and the prompt action of the Highway Commission in reaching a basis for a working agreement, are highly appreciated by Mayor Lapham, Mr. Dill, and myself.

"We will now be able to proceed much more rapidly toward completion of the master plan for the airport and hasten the date when it will take its rightful position as the leading airport in the west."

RESOLUTION

WHEREAS, The City and County of San Francisco, through the Mayor and Public Utilities Commission, have informed the California Highway Commission of its desire to enlarge the San Francisco Municipal Airport, known as "Mills Field," by stage construction, both to the east and west of the existing airport as its ultimate program; and

WHEREAS, The City and County of San Francisco has requested the removal of a portion of State Highway Route 68 so as to clear the same for use for airport purposes; and

WHEREAS, The City and County of San Francisco offers to construct a facility equal and equivalent to the standard of the existing road on a location to be selected by the California Highway Commission; and

WHEREAS, The City and County of San Francisco offers to build the additional length of completed freeway required over that necessary had the State Highway remained in its present position; and

WHEREAS, The City and County of San Francisco offers to furnish a right of way satisfactory to the State through city owned property; now, therefore, be it

Resolved, That the California Highway Commission agrees to relinquish title to its present right of way when the City and County of San Francisco enters into an agreement with the State in accordance with the offers hereinabove recited and when such relocated highway has been constructed; and it is further

Resolved, That on acceptance of the conditions in this resolution by the legally authorized authority of the City and County of San Francisco, the State Highway Engineer will be instructed to proceed with the completion of the engineering involved.

Access Defense Highway Construction In District XI Aggregates $8,000,000

By E. E. WALLACE, District Engineer

IN December, 1941, after the [illegible] into the war, the San Diego highway facilities were inadequate to carry the existing traffic. U. S. Highway 101 leading into San Diego from the north carried over 40,000 vehicles per day at the Barnett-Pacific Highway intersection and serious congestion was the result.

In October, 1940, prior to the final passage by Congress of the Defense Highway Act of 1941, a conference was held in San Diego at the office of the Commandant of the Eleventh Naval District which was attended by representatives of the Navy and Army, the U. S. Public Roads Administration and the State Division of Highways. At that conference a system of Access Highways was designated which was intended to provide needed relief from traffic congestion in serving the naval and defense activities in this area.

Work was immediately started on surveys and plans with the result that several important projects were under construction early in 1942.

HUGE PROGRAM

Subsequently this district has handled an Access Highway construction program amounting to over eight million dollars, or more than twice the usual volume of work assigned to this area. This has been accomplished in spite of the unusual stress of conditions in a very critical defense area, where labor and material conditions are exceedingly difficult.

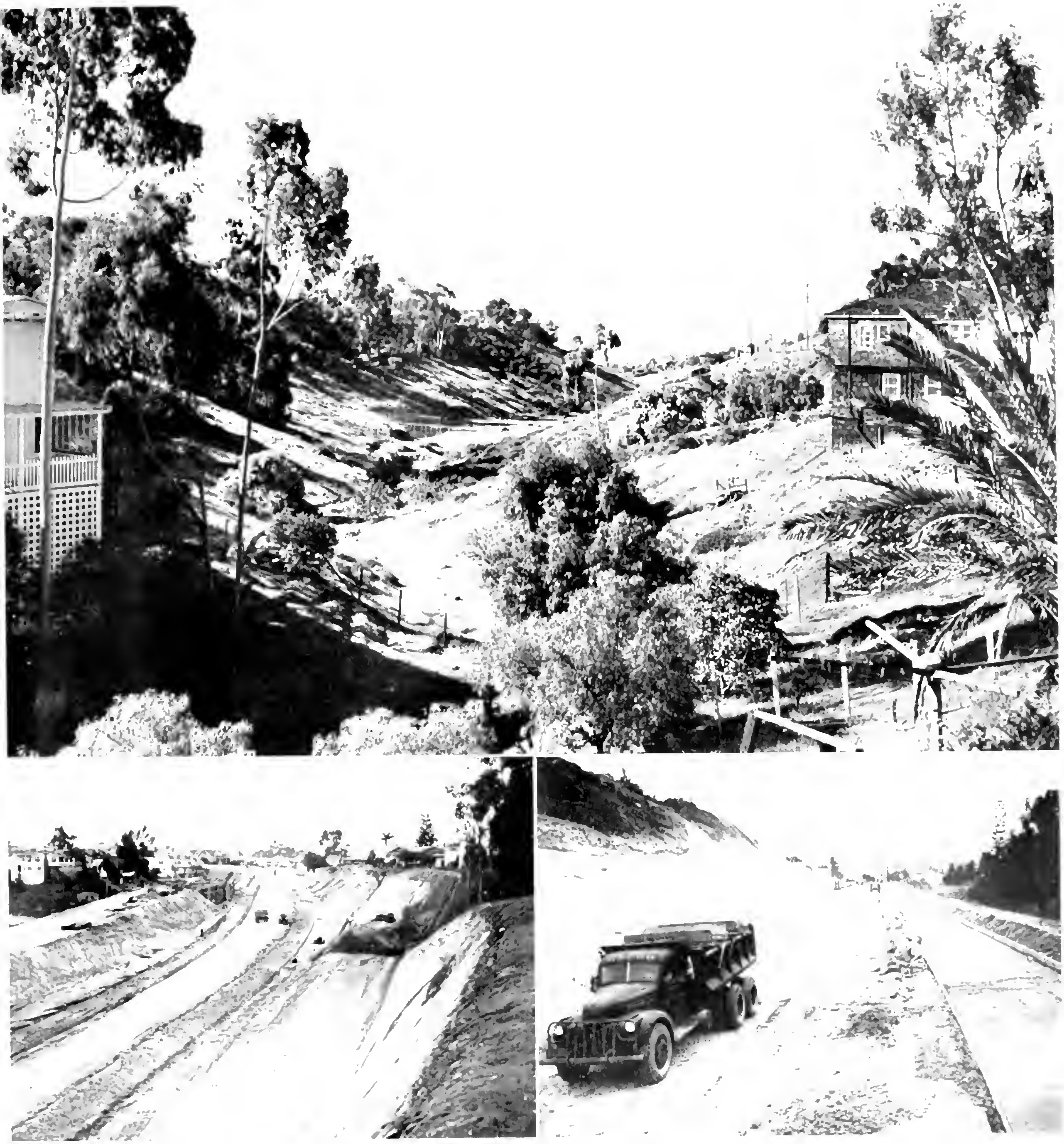
Another serious handicap has been the loss to this district of 53 engineers and maintenance and construction employees to the armed services of the United States, and the fact that replacement of such experienced help has been impossible.

The construction work has not been confined to the San Diego area alone. Projects have been completed in Imperial and San Diego counties to provide access to airports, Army camps, sources of raw materials, amphibious bases, Marine camps and ammunition depots.

To date 32 access projects have been approved of which 26 have been completed, and six are in various stages of construction. Of these, only 12 projects were on the State Highway System, though four on Harbor Drive have since been added to the State System.

All of the projects in the Access

View of the Mission Valley Overpass in San Diego, looking south from the San Diego River



Before and after views of Douglass Street extension in San Diego. Upper picture shows route between Pacific Highway and Washington Street before grading operations (lower) began

system as designated at the conference above referred to have been completed with the exception of the relocation of U. S. Highway 395 through Balboa Park; this project has been indefinitely deferred due to its magnitude and the continuing labor shortage in this area.

Some of the more important Access projects in District XI are briefly described as follows:

Pacific Highway in San Diego, between Market Street and the San Diego River, has been widened to a six lane, divided highway, paved and resurfaced. Highway grade separations have been installed at Barnett, Witherby and Mission Valley intersections.

(Continued on page [illegible])

CALIFORNIA MISSIONS

By KENNETH C. ADAMS, Editor

PREFACE

CALIFORNIA'S 21 Franciscan missions were established by members of the Order of Friars Minor, led and inspired by Fray Miguel Joseph Serra, famous in history as Father Junipero Serra.

St. Francis of Assisi, Italy, founded the Order of Friars Minor, better known as the Order of Franciscan Monks, in 1209. It is a missionary brotherhood bound together by the vows of Poverty, Obedience and Chastity. Leaders of the Order in the 17th century conceived plans for a communal mission life in which Friars might create protected establishments and gather about them in family groups aboriginal people among whom they worked. Experimented with for the first time in Sinaloa, Mexico, in 1611 the plan proved successful and was adopted by the Jesuit Order in Lower California. The system was perfected by the Franciscans in Alta (Upper) California, which now is the State of California.

To Father Serra belongs the credit for the far-flung perfect mission system which played so large a part in the early history of this State.

Born in humble circumstances on the Island of Majorca in 1713, Miguel Joseph Serra entered the Franciscan Order before he was 17. He took the name of Junipero out of reverence for the chosen companion of St. Francis and as a youth dedicated himself to missionary work. It was not until 1749, however, that the opportunity for service in foreign fields came to him. In that year, to his unbounded joy, he and Father Francesco Palou, his friend and biographer, were appointed members of a group of priests requested by the College of San Fernando, Mexico, for duty in the New World.

ARDUOUS TRIP

Of Father Serra's long and arduous trip from Majorca to the City of Mexico much has been written by that faithful chronicler, Father Palou, and many historians and writers. It is related that when Father Serra arrived at Vera Cruz so eager was he to plunge into his new apostolic duties that he would not wait for the mules and wagons, which were to transport him and his colleagues to Mexico City, and which had been delayed, and so set out on foot for his destination. He paid dearly for his impetuosity. An ulcer developed in one of his legs and throughout his life he suffered from it. On several occasions the infection brought him near to death.

> ## Mission Meccas
>
> **California's famous old missions with their historical and romantic background annually attract thousands of visitors. Twenty-one Franciscan missions were founded by the Reverend Fray Junipero Serra and his colleagues, extending from San Diego to Sonoma. On his way north from San Diego, Father Serra and the mission padres who came after him followed a course which became known as El Camino Real, "The King's Highway." El Camino Real retains to this day its original name and is designated U. S. 101. Along this highway and short distances from it, the founding padres established their missions. U. S. 101, the old "King's Highway," now extends from the Mexican border to the Oregon boundary line.**
>
> **Present day State highways lead to all the mission sites. When the war is ended and California again welcomes tourists from all over the world and there are no longer restrictions on automobile travel, it is believed that the missions will be popular meccas for visitors to the Golden State.**
>
> **Anticipating this traffic, the Division of Highways will publish in California Highways and Public Works brief histories of the missions with directions on how to reach them over State highways. For the purpose of this series, the missions will be taken up in the order of their locations from south to north, rather than in the sequence of their founding.**
>
> **This is the first of the series.**

Father Serra engaged in missionary work in Mexico for nearly 19 years and then was rewarded by appointment as president of the Missions of California which, following expulsion of the Jesuits in 1768, had passed into the control of the Franciscans. There were 13 of these missions, all in Lower California. Father Serra was 55 years of age when his chance to extend the missions to Upper California came.

Jose de Galvez had been sent out to New Spain by Carlos III as visitador general of the provinces with instructions to establish military posts at San Diego and Monterey to prevent encroachments of the English and Russians. Announcing organization of an expedition into the north, Galvez stated that its purpose was "to establish the Catholic faith among a numerous heathen people, submerged in the obscure darkness of paganism, and to extend the dominion of the King, our Lord, and protect this peninsula from the ambitious views of foreign Nations."

EXPEDITIONS FORMED

Assembling his forces at Santa Ana, near La Paz, Galvez invited Father Serra, then at Loreto, to visit him. Junipero enthusiastically made the long trip to Santa Ana and inspired by the prospect of a great new missionary field, joined up with Galvez.

The soldier and the priest decided that their joint expedition should be divided and sent to San Diego in two sections, one by land and one by sea. Three ships, the San Carlos, the San Antonio and San Joseph, carrying troops and four missionaries, sailed from La Paz on January 9, February 15 and June 16, 1769, in the order named.

Driven off her course by storms, the San Carlos arrived at San Diego 20 days after the San Antonio, although she had sailed five weeks earlier, and of her crew all but one sailor and the cook had succumbed to scurvy and many of the soldiers had died. The San Antonio lost eight of her crew from the same disease. The San Joseph was lost at sea.

The land expedition was divided ito two divisions under Captain Ferando Rivera y Moncada and Governor on Gaspar de Portola. Captain Monada led the advance detachment and ortola followed. Father Serra was to ave accompanied the Governor, but hen the date of departure came his lcerous leg kept him in bed and Porola went on without him.

INDOMITABLE SPIRIT

It was not until March 28th, several eeks later, that Father Serra with vo soldiers and a servant set out on uleback to overtake the expedition. e suffered greatly enroute, but aught up with Portola. His condition ecame so grave that the Governor beought him to return to San Fernando or treatment. This Junipero would ot do. His life was despaired of.

And then, records Father Palou, the ndomitable Serra, after offering up a rayer, called one of the muleteers and aid to him: "Son, do you not know ow to make a remedy for the ulcer on y foot and leg?" And the muleteer nswered, "Father, how should I know f any remedy? Am I a surgeon? I n a mule-driver, and can only cure arness wounds on animals." "Then, on," Father Serra directed, "consider hat I am an animal and that this ulcer a harness-wound and prepare for me ne same medicament as you would ake for a beast."

This cross marks site of original Mission San Diego de Alcala Photo by Byron Dome

Unwillingly, the muleteer obeyed, applied his preparation to the infected leg and to the astonishment of all, the good Father slept that night and the next morning was able to resume the journey.

After many hardships, Portola reached San Diego on July 1, 1769. There he found Moncada and his force and the San Carlos and San Antonio with the surviving members of the sea expedition. And there Father Serra found his new field of endeavor of which he long had dreamed.

View of court yard in Mission San Diego de Alcala, showing ancient walls

Photo by Byron Dome

Mission San Diego de Alcala July 16, 1769

WHEN Father Junipero Serra arrived at San Diego with Governor Gaspar de Portola after their arduous march from La Paz the conditions they found there were enough to discourage a far stouter heart than the valiant priest's. Many soldiers and sailors of the sea expedition had died from scurvy and the survivors still were suffering from the disease.

But, as Father Palou recorded, "that fervent zeal which continually glowed and burned in the heart of our venerable Father Junipero did not permit him to forget the principal object of his journey."

Two weeks after the arrival of the land force, Governor Portola, under orders to locate Monterey Bay and establish there a presidio, departed for the north with a small expedition on July 14, 1769. And two days later, Sunday, July 16th, Father Serra, impatient to take up his task of converting the Indians to Christianity, founded the first mission in California.

For the location of his mission, Father Serra selected a site adjoining the Spanish camp. Until this day, Holy Mass had been celebrated in a brushwood shelter and for the Spaniards only. The date selected for the establishment of the mission was an appropriate one, as Father Palou observed; for on that day, in the year 1212, the Spaniards fighting under the banner of the Holy Cross won an historical victory over the Mohammedans, which annually was celebrated by the Spanish church as the Triumph of the Holy Cross.

CROSS RAISED

"Furthermore," says Father Zephyrin Engelhardt, mission historian, "it was the day of Our Lady of Mount Carmel, through whose intercession Father Serra hoped to wean the savages from their beastly practices and induce them to accept the ennobling Faith of Christ."

Assisted by Fathers Vizcaina and Parron, Father Serra, on the morn-

[illegible]

[illegible] Serra and his missionaries [illegible] Indians unfriendly [illegible] savages accepted pres[ents] [illegible] and clothing [illegible] but would not [illegible] of the Spaniards' food [illegible] deaths and sickness [illegible] the invaders were caused by [illegible]. This fear [illegible] Father Palou later [illegible] [illegible] the natives taken [illegible] the Spaniards [illegible] expedition [illegible].

[illegible] Father Serra nevertheless [illegible] work of converting [illegible] Vizcaino [illegible] the missionaries [illegible]

[illegible] who picked up a smattering [illegible] Spanish was used as an interpreter.

INDIANS ATTACK

Coveting trinkets and clothing [illegible] Indians became bolder in their thie[very] [illegible] and being ignorant of firearms they jeered the soldiers. Less than [illegible] after the mission was started [illegible] band of savages attacked but w[ere] driven off, the Spaniards retaining [illegible]

Two days later, while four soldiers comprising the mission guard were absent watering their horses and Fathers Serra and Vizcaino and [illegible] workers and servants were [illegible] protected, the savages attacked [illegible]. Father Vizcaino and sever[al] others were wounded by arrows [illegible] the soldiers returned and opened [illegible] Joseph Maria, a servant, died [illegible]

Recent photograph of Mission San Diego de Alcala taken from exterior and showing restored tower

REMINISCENCE

By R. L. THOMAS,
Senior Highway Engineer

THE other day while looking over some musty photographs of Division of Highways field parties on arly road surveys in Mendocino ounty it occurred to me that unpre- entious as the old ways were and im- roved as the new ways are, the prog ess has not been made without the loss f an indefinable something which only n old time jungle bird or ridge runner an feel and understand

WHENEVER I see one of our field parties starting on an assignment ith its station wagon loaded with effi ently placed survey instruments and quipment I can not help but think at much of the romance of highway ngineering that the rider of the sta on wagon might well regret having issed went out with the long hiker I ondly remember, as does any S. I. of e old school:

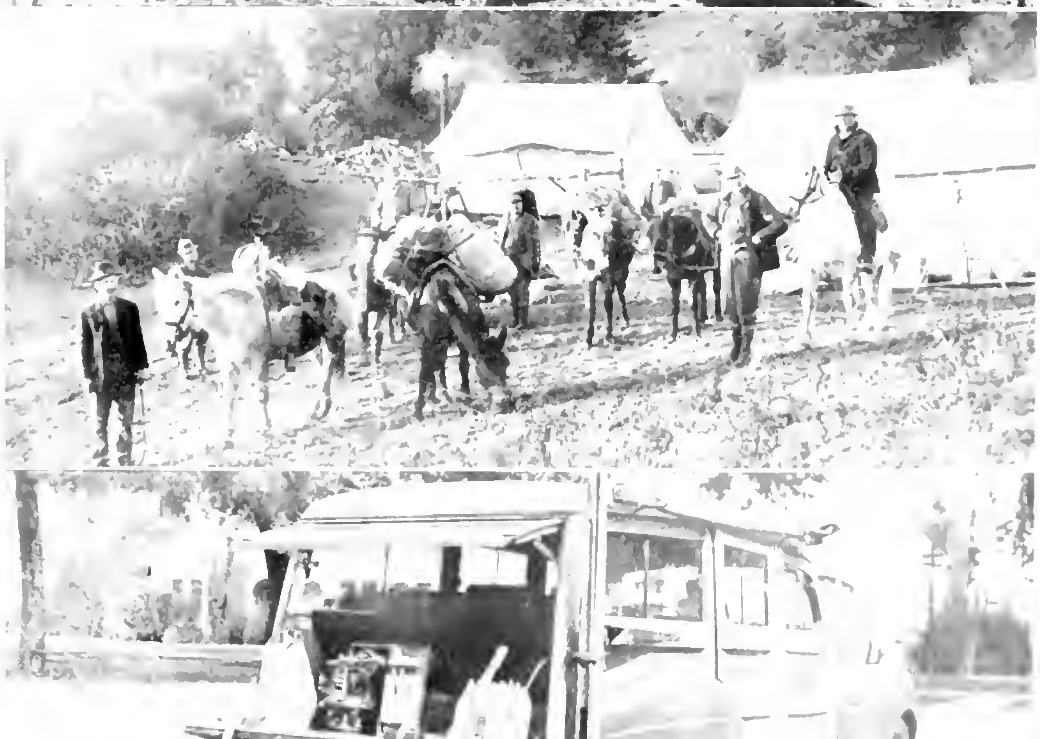
THE unlimited field, the intriguing and fascinating brush line reach- ng endlessly onward into the un- nown; the Silver Arc that holds the irection, the rhythmic flash and ound of axe and bolo in the virgin rowth ahead; the development of the one, with the finished and staked esign bringing up the rear, and the ense of achievement as each control is assed;

THE spirit and comradeship of the camp in the wilderness that held e crew together in contact with the ommon interest in the work; the rganization based on the survival of e fittest and the elimination of the nfit, and the united effort for in reased efficiency;

THE night work in the office tent, the camp study classes, with col ge boys for mentors and the chief for e last guess;

THE pack train or horse teams that maintained contact with the out- de world; the teamsters and packers ho shaved only when there were com- laints that it was visually uncertain here the horse ended and where the an began. This was the life.

HAIL to those who have lived it, and loved it!



These photos contrast the early day equipment of field parties of Division of Highways and the modern transportation afforded State road surveyors and their instruments and equipment. The three upper pictures were taken in Mendocino County in the year 1913

State Builds Military Roads in Napa and Solano Counties Costing $4,358,600

By P. O. HARDING, District Engineer

One of the important contributions of District X of the Division of Highways to the war effort involved the construction in Solano and Napa counties for the Navy and the Army of approximately 40 miles of State highway access roads costing $3,758,300, and 18 miles of such projects off the State Highway System, which raised the total of expenditures, including costs of right of way, for the military access program in these two counties to $4,358,600.

The military access program of District X is located in three general areas, as follows:

(a) The mountain area where raw material access projects, both on and off the highway system, serve the forest and mine raw material sources of supply. The district has previously reported in CALIFORNIA HIGHWAYS AND PUBLIC WORKS on two important projects of this type but our program, while well advanced in these mountain sections, is still under way.

(b) The San Joaquin Valley area, more particularly that area adjacent to Stockton and its concentration of war activities, serves both the Army and Navy branches of service.

(c) Lower Solano and Napa counties under the direct influence and sponsorship of Mare Island Navy Yard and the Army's Benicia Arsenal.

No report has heretofore been made on any of the Army and Navy projects although a number of the more important ones were completed as early as two years ago. At that time of rigid blackout control at night, and with the sky filled with barrage balloons and every vantage point occupied with on-the-alert anti-aircraft installations both day and night, military censorship precluded the projects being unduly publicized.

IMPORTANT AREA

The most important of the three areas listed above is that area in lower Solano and Napa counties under the influence of the Army from Benicia, with its arsenal, to Vallejo; and extending under the still greater influence of the Mare Island Navy Yard dominating Vallejo and the tributary area up the Napa River Valley to Napa. With the pouring of concrete pavement near completion on the Casson-Ball contract on Route 8 between Suscol Creek and Napa, District X expects to wind up its access program of highway construction in this important area soon.

It will be noted that this area includes a portion of Napa County, in which some 10½ miles of State highway construction lie within the limits of District IV. Due to the close relationship which this section of highway bears to the remainder of the program in District X, this district was requested to handle it as a part of its program. We have been required, however, to borrow some of District IV construction personnel to complete this important work due to the general war depletion of all district engineering personnel.

Excluding several access projects for the Fairfield-Suisun Airfield and one in the town of Benicia, being handled directly by the Public Roads Ad-

View of new four-lane highway between Napa Wye and Vallejo before paving operations. New lane is on right

This photograph shows paving operations in progress on Vallejo-Napa highway between Napa Wye and Napa City

ministration and not otherwise commented on here, the Army and Navy access program of lower Solano and Napa counties handled by District X involves:

FIFTEEN CONTRACTS

(a) Fifteen contracts, three of which were sponsored by the Benicia Arsenal and 12 by the Mare Island Navy Yard.

(b) The construction of some 40 miles of State highway, approximately 10 miles of which were for the Army and 30 for the Navy.

(c) The construction of roads and streets off the State Highway System of some 18 miles, 1½ of which were for the Army and 16½ for the Navy.

(d) Construction costs of $899,700 on the State Highway System for the Army and $2,595,700 for the Navy, making a total of $3,495,400. Construction costs on roads and streets off the highway system of $103,000 for the Army and $497,300 for the Navy, making a total of $600,300.

(e) The acquisition of 157 parcels of right of way for the Army at an approximate cost of $66,000 and 109 parcels of right of way for the Navy at an approximate cost of $196,900, making a total of approximately $262,900, all being involved on the State Highway System.

(f) The preceding gives a total cost of $3,758,300 for the 40 miles of State highway construction, and a grand total of $4,358,600 for 58 miles of total roads involved.

All of the work was performed by 10 California contracting firms. The contract of one of these contractors involved the redecking of the important Napa River bascule bridge and trestle approaches on the Sears Point Highway. The remaining nine contractors had the remaining 14 general contracts covering road construction which included one major highway grade separation structure and several major bridge structures as a part of the road contract. In addition to the above contractors, the Basalt Rock Company constructed to the design furnished by the Division of Highways a highway underpass structure which will segregate its important quarrying transport from the main quarries east of the highway to the railroad and water shipment points west of the highway. This was performed at the company's expense but under agreement will be deeded to the State with the final acceptance of the adjacent road contract.

MANY DIFFICULTIES

The performance of the work involved in this program would have been difficult under normal conditions. War condition with all of the attendant problems multiplied the difficulties many fold. In this regard, conditions of this area are undoubtedly indicative of comparable or possibly worse conditions elsewhere in the State in any of the major critical war effort areas. Prior to the war the population of Vallejo township, which includes Vallejo and suburban territory, was approximately 30,000. This population has grown to over 100,000, and is still expanding. Comparable expansion has occurred at Benicia and surrounding territory due to the influence of the arsenal. Similar growth has also occurred at Napa due to the influence of the Basalt shipyards located on the Napa River west of the highway about 2½ miles south of Napa.

This tremendous expansion of population has resulted in the construction of some 15,000 governmental housing units and other thousands of units of private housing, generally inflated realty values, greatly increasing the difficulties of acquiring rights of way, inadequate restaurant facilities and many other attendant obstacles.

BIG POPULATION INCREASE

The general increase of population of this area is not indicative of expansion of the military facilities of the area. It is understood that the per-

(Continued on page 17)

Monterey-Castroville-Prunedale Project Provides Modern Highway From Del Monte Junction to Route 2

By C. E. WAITE, District Construction Engineer

THE recent completion of the contract on Route 56 between Seaside Junction and the North Reservation Boundary of Fort Ord now provides a modern highway from Del Monte Junction, just east of the City of Monterey, to Route 2 near Prunedale via Castroville, with the exception of the three-mile section between Del Monte Junction and Seaside Junction. This latter section is included in the postwar program and is planned for construction as soon as funds are made available.

The Seaside Junction-North Reservation Boundary project is the last of nine completed road and bridge contracts financed with Federal Access Highway Funds on Routes 56 and 22, providing access from Fort Ord to Route 2 (U. S. 101) near Prunedale. In addition to providing a modern access highway for the large military establishment at Fort Ord, the new highway will be of immeasurable benefit to postwar traffic between Monterey and points north. This routing has an advantage of approximately six miles over the highway through Salinas via Routes 2 and 117, in addition to which less traffic congestion and delay will be encountered.

With the completion of the postwar project between Del Monte Junction and Seaside Junction, approximately nine miles of this 19.5 mile section will be four-lane divided, all of which will be on the Monterey end of the section.

The first bids for construction were received on March 4, 1942, at which time they were submitted for the Neponset Bridge across the Salinas River near Castroville and for the highway construction between Castroville and Route 2, near Prunedale.

Following is a brief description of the various projects involved which will be discussed in order, running from Monterey to Route 2.

DEL MONTE JUNCTION TO SEASIDE JUNCTION

(1) This is postwar project No. 45 and is designed for four-lane divided portland cement concrete pavement approximately three miles in length. Plans and specifications have been prepared on this project and approximately two-thirds of the right of way acquired.

Looking southerly toward Marina on completed 4-lane, divided Portland cement concrete pavement. Road to left in foreground is Monterey Avenue, a county road to Salinas via East Garrison of Fort Ord

Completed 2-lane Portland cement concrete pavement between Marina and Castroville. Paved gutters and erosion protection on slopes show in this picture

SEASIDE JUNCTION TO NORTH BOUNDARY OF FORT ORD

(2) This contract for approximately 4.5 miles of grading and surfacing was awarded to M. J. Ruddy and Son on June 23, 1943, and accepted on June 23, 1944. The existing road prior to construction consisted of a four-lane divided highway with about 1.5 miles of inferior alignment and grade and rapidly deteriorating surfacing on the easterly or northbound lanes. The westerly lanes consisted of an armor coat surfacing 20-24 feet wide on an old bituminous macadam and crusher run base 8 inches thick. The easterly lanes, constructed in 1940 by Monterey County under a WPA project, consisted of an armor coat 24 feet wide on a 6-inch decomposed granite base and as above stated was rapidly disintegrating.

The proposed project consisted of constructing about 1.5 miles of grade

Looking southerly toward Monterey on Seaside Junction-North Reservation Boundary project, showing completed armor coat surfacing and planting in dividing strip

Completed crusher run base with armor coat surfacing between Seaside Junction and North Boundary of Fort Ord

and line changes on both lanes and reworking and resurfacing the remaining portions of the easterly lanes. In addition to this, three short dips on the westerly lanes were eliminated by grade changes.

New construction on the line and grade changes provided for an armor coat on 0.67-foot of salvaged and crusher run base, while on the resurfaced sections, the work consisted of reworking and compacting the existing surfacing which was covered with 0.4-foot of crusher run base and an armor coat.

Work on this project was suspended from February 17, 1941, to May 10, 1941, during which time the unsurfaced crusher run base was protected by the application of a seal coat with screenings.

FORT ORD PEDESTRIAN CROSSINGS

(3) This contract was awarded to Dan Caputo, Contractor, on June 5, 1942, and accepted on March 1, 1943. These structures, one overhead and one underpass, provided separated grades for troop and equipment movements across the State Highway and adjacent branch line of the Southern Pacific Railroad. These structures are constructed of reinforced concrete and provide a 14 foot clear roadway width.

NORTH BOUNDARY OF FORT ORD TO MARINA

(4) This contract was awarded to W. J. Wilkinson and H. B. Scott on July 1, 1942, and accepted March 19, 1943. The work consisted of constructing a four-lane divided highway of portland cement concrete pavement with curbs along the dividing strips. This unit is approximately 1.5 miles in length with a transition to a two-lane highway at its northerly end.

Because of the shortage of critical materials, the pavement was built without steel dowels or reinforcing, the thickened end section being utilized at transverse expansion joints. Shoulders were standard 8-foot width, being surfaced with salvaged surfacing and crusher run base covered with a seal coat and medium screenings.

MARINA TO CASTROVILLE

(5) Contract awarded to Granite Construction Company on April 16, 1942 and accepted March 17, 1943. This project was built concurrently with the preceding project, the contractors' organizations being the same on both sections although bid under different names.

This work consisted of constructing a two-lane portland cement concrete pavement with 8 feet wide crusher run base shoulders covered with a seal coat. Berms and gutters were surfaced in the same manner as the shoulders to prevent erosion of the sandy soil which predominates in this area.

This project is 5.3 miles in length including the Neponset Bridge across the Salinas River and the bridge across Tembladero Slough, which were built under separate contracts.

NEPONSET BRIDGE ACROSS SALINAS RIVER

(6) This contract was awarded to Harry J. Oser and Peter Sorenson on March 11, 1942, and accepted on October 28, 1943, nearly a year later than the anticipated date of completion. The large overrun in time was due to delay in securing steel with the priority available and the washing out of the detour bridge twice within a period of approximately seven weeks.

The new bridge is of the continuous steel girder type, on concrete piers with a reinforced concrete deck, concrete curb and timber railing. It is 785 feet in length and has a roadway width of 26 feet.

The original through truss steel bridge at this site was constructed in 1914 and during the latter part of 1941 was posted for three tons and a five-mile-an-hour speed limit. Because this road was the outlet from Fort Ord to the north, a detour bridge was built early in 1942 to serve traffic until completion of the new structure, which was scheduled for the fall of 1942.

This detour bridge, which was not planned to withstand winter floods, was washed out January 23, 1943, replaced and washed out again March 10, 1943, just before it was to have been placed in use. It was replaced the second time and served until traffic was turned over the new bridge, after which the detour bridge was removed

(Continued on page 26)

Traffic Count on State Highways Shows Little Change Over Last Year

By G. T. McCOY, State Highway Engineer

THE annual state-wide traffic count taken on Sunday and Monday, July 16th and 17th, in harp contrast with the two last previous counts of 1942 and 1943, shows little change from the preceding year.

While rather wide variations are to e found among the various individual outes, the over-all picture indicates ssentially the same volume of traffic as hat which was recorded during the 1943 annual count. Sunday traffic still hows a slight but measurable decline f approximately 4 per cent, but traffic uring the normal working days of the veek, which account for the preponderant part of the total travel, remains at so nearly the same level as a ear ago that the calculated difference ased on a summary of Routes 1 to 80 nclusive, as given below, amounts to nly 1½ per cent.

The marked decline in highway traffic from the peak year of 1941 is shown y the records of our monthly counts t key stations to have reached its lowest level about December of 1942. This vas followed by a slight upturn in otal traffic which continued until September of 1943. This pickup from the ow point was, however, less than the ormally expected seasonal increase.

The volume since then has remained airly constant, with the combined otal for the first seven months of the resent year showing an approximate ncrease of 2.8 per cent over the corresponding period of 1943. Commercial traffic has continued throughout he entire period at a consistently high evel, freight vehicles now constituting pproximately 22 per cent of all vehicles recorded.

No change was made from the regular procedure of previous years in the nanner of taking the count. Actual recording covers the 16-hour period from 6 a.m. to 10 p.m. for both Sunday and Monday. Traffic was segregated by hourly periods into the following vehicle classifications: California passenger cars, out-of-State passenger cars, buses, light trucks, heavy trucks, trailers drawn by trucks, trailer coaches, and other passenger car trailers.

Each year some minor changes in the census become necessary, such as the relocation, addition, or discontinuance of individual stations; but in every instance these are excluded when determining comparisons with the previous year, only those stations that were identical during both years being taken into consideration.

These comparisons for the various route groups are as follows:

PER CENT GAIN OR LOSS FOR 1944 COUNT AS COMPARED WITH 1943

	Sunday	Monday
All Routes	—4.47	—1.56
Main North and South Routes	—3.59	—0.05
Interstate Connections	—13.18	—12.94
Laterals between Inland and Coast	—8.27	—4.89
Recreational Routes	—7.12	—1.19

The gain or loss of traffic volume for State Highway Routes 1 to 80 inclusive, which constitute the basis for the foregoing summary, is shown in the following tabulation:

1944 Per cent gain or loss

Route	Termini	Sunday Gain	Sunday Loss	Monday Gain	Monday Loss
1.	Sausalito-Oregon Line		4.66		1.66
2.	Mexico Line-San Francisco		5.97	2.76	
3.	Sacramento-Oregon Line		6.83		6.79
4.	Los Angeles-Sacramento	0.99			0.18
5.	Santa Cruz-Jc. Rt. 65 near Mokelumne Hill		5.63	5.29	
6.	Napa-Sacramento via Winters		4.38		0.11
7.	Crockett-Red Bluff		1.63	2.79	
8.	Ignacio-Cordelia via Napa		8.83		9.36
9.	Rt. 2 near Montalvo-San Bernardino		9.98		8.01
10.	Rt. 2 at San Lucas-Sequoia National Park	11.99		3.98	
11.	Rt. 75 near Antioch-Nevada Line via Placerville		6.89		11.38
12.	San Diego-El Centro		10.25		0.37
13.	Rt. 4 at Salida-Rt. 23 at Sonora Jc.	18.69		25.97	
14.	Albany-Martinez		15.61		14.16
15.	Rt. 1 near Calpella-Rt. 37 near Cisco		8.89		17.88
16.	Hopland-Lakeport		6.04	12.56	
17.	Rt. 3 at Roseville-Rt. 15, Nevada City		5.25		21.13
18.	Rt. 4 at Merced-Yosemite National Park	1.42		17.08	
19.	Rt. 2 at Fullerton-Rt. 26 at Beaumont		15.35		6.84
20.	Rt. 1 near Arcata-Rt. 83 at Park Boundary		10.09		0.74
21.	Rt. 3 near Richvale-Rt. 29 near Chilcoot via Quincy	19.86		27.94	
22.	Rt. 56, Castroville-Rt. 29 via Hollister	14.10		32.35	
23.	Rt. 4 at Tunnel Sta.-Rt. 11 Alpine Jc.	19.63		8.39	
24.	Rt. 4 near Lodi-Nevada State Line		7.00	1.76	
25.	Rt. 37 at Colfax-Rt. 83 near Sattley	10.86		7.40	
26.	Los Angeles-Mexico via San Bernardino		10.64		8.69
27.	El Centro-Yuma		6.12		14.42
28.	Redding-Nevada Line via Alturas	0.66			7.21
29.	Peanut-Nevada Line near Purdy's		20.02	0.92	
31.	Colton-Nevada State Line		18.69		7.74
32.	Rt. 56, Watsonville-Rt. 4 near Califa	2.68		5.98	
33.	Rt. 56 near Cambria-Rt. 4 near Famoso	14.72		6.80	
34.	Rt. 4 at Galt-Rt. 23 at Pickett's Jc.	11.59		10.88	
35.	Rt. 1 at Alton-Rt. 20 at Douglas City	3.38			0.75
37.	Auburn-Truckee		2.27		20.65
38.	Rt. 11 at Mays-Nevada Line via Truckee River	15.08		18.49	
39.	Rt. 38 at Tahoe City-Nevada State Line	25.46		38.08	
40.	Rt. 13 near Montezuma-Rt. 76 at Benton	19.79		26.90	
41.	Rt. 5 near Tracy-Kings River Canyon via Fresno	5.70		3.40	
42.	Redwood Park-Los Gatos		20.83		8.48
43.	Rt. 60 at Newport Beach-Rt. 31 near Victorville		8.16		1.07
44.	Boulder Creek-Redwood Park		5.62	33.44	
45.	Rt. 7, Willows-Rt. 3 near Biggs	7.86			7.14
46.	Rt. 1 near Klamath-Rt. 3 near Cray	0.51			0.64
47.	Rt. 7, Orland-Rt. 29 near Morgan		4.58		2.62
48.	Rt. 1 N. of Cloverdale-Rt. 56 near Albion	17.74		9.48	
49.	Napa-Rt. 15 near Sweet Hollow Summit		4.69		3.30
50.	Sacramento-Rt. 15 near Wilbur Springs		2.70	0.11	
51.	Rt. 8 at Schellville-Sebastopol	0.88			1.71
52.	Alto-Tiburon		14.44		14.50
53.	Rt. 7 at Fairfield-Rt. 4 near Lodi via Rio Vista	8.56		10.37	
54.	Rt. 11 at Perkins-Rt. 65 at Central House		25.64		24.04
55.	Rt. 5 near Glenwood-San Francisco		4.31		15.15
56.	Rt. 2 at Las Cruces-Rt. 1 near Fernbridge		13.64		7.72
57.	Rt. 2 near Santa Maria-Rt. 23 near Freeman via Bakersfield	9.60		13.35	
58.	Rt. 2 near Santa Margarita-Arizona Line near Topock via Mojave and Barstow	1.18			4.44
59.	Rt. 4 at Gorman-Rt. 43 at Lake Arrowhead		6.69	5.04	
60.	Rt. 2 at Serra-Rt. 2 at El Rio	1.92		5.54	
61.	Rt. 4 S. of Glendale-Rt. 59 near Phelan		11.05		9.45
62.	Rt. 171 at Northam-Rt. 61 near Crystal Lake		2.12	0.08	
63.	Big Pine-Nevada State Line	21.90		46.09	
64.	Rt. 2 at San Juan Capistrano-Blythe		25.43		30.10
65.	Rt. 18 near Mariposa-Auburn	2.64		10.28	
66.	Rt. 5 near Mossdale-Rt. 13 near Oakdale		13.07		3.05
67.	Pajaro River-Rt. 2 near San Benito River Bridge		14.15	1.01	
68.	San Jose-San Francisco		15.54		7.75
69.	Rt. 5 at Warm Springs-Rt. 1 San Rafael		10.47		7.54
70.	Ukiah-Talmage	6.61			9.42
71.	Crescent City-Oregon Line	2.84			0.38
72.	Weed-Oregon Line		29.91		33.72
73.	Rt. 29 near Johnstonville-Oregon Line	0.52		16.65	
74.	Napa Wye-Cordelia via Vallejo and Benicia		18.83		20.01
75.	Oakland-Jc. Rt. 65 at Altaville		3.87		8.45
76.	Rt. 125 at Shaw Ave.-Nevada State Line near Benton	8.53		4.65	
77.	San Diego-Los Angeles via Pomona		7.52	0.40	
78.	Rt. 12 near Descanso-Rt. 19 near March Field		12.71		7.56
79.	Rt. 2, Ventura-Rt. 4 at Castaic		4.86	3.68	
80.	Rt. 51 Rincon Creek-Rt. 2 near Zaca	2.87			10.92

Alamitos Bay and Ocean Park Project Undertaken by State and County Agencies

IMPROVEMENT of Alamitos Bay and Ocean Beach in Los Angeles County, a cooperative project financed by the State Park Commission from funds appropriated by the 1941 Legislature, in the amount of $100,000, and by contributions from the County of Los Angeles and City of Long Beach in the amounts of $65,000 each, making a total of $230,000, is under way. The Department of Public Works, Division of Water Resources, is the construction agency. The purpose of the project is to replenish sand on the ocean beach in the vicinity of Alamitos Bay, deepen the bay and dredge a new entrance channel to provide an initial unit for a yacht harbor.

The project is one of three parts of a larger cooperative undertaking to assist the war effort by increasing the production of electric energy at the Seal Beach steam electric plant of the Department of Water and Power of the City of Los Angeles.

CHANNEL CLOSED

The present entrance channel to Alamitos Bay connects with the San Gabriel River through its right bank at a point approximately one-eighth of a mile upstream from the river's mouth. The steam electric plant is located on the left bank of the San Gabriel River slightly downstream from the entrance channel and secures its cooling water from the river through an intake at the upstream end of the plant.

Difficulty in securing adequate amounts of cooling water has been experienced due to silting up of the river channel by flood waters and by tidal action. A considerable amount of maintenance is required to maintain adequate depths at the present cooling water inlet. For this reason, it was decided to close off the existing entrance channel to the bay, dredge a new channel parallel to and immediately west of the river channel and install a cooling water intake structure with an inlet in Alamitos Bay, where it would not be affected by the debris carried by the river when in flood.

The Los Angeles County Flood Control District's project consists of construction of a levee between the existing right bank jetty of the San Gabriel River and the existing levee approximately 800 feet upstream, which will result in closing the present entrance to Alamitos Bay from the San Gabriel River.

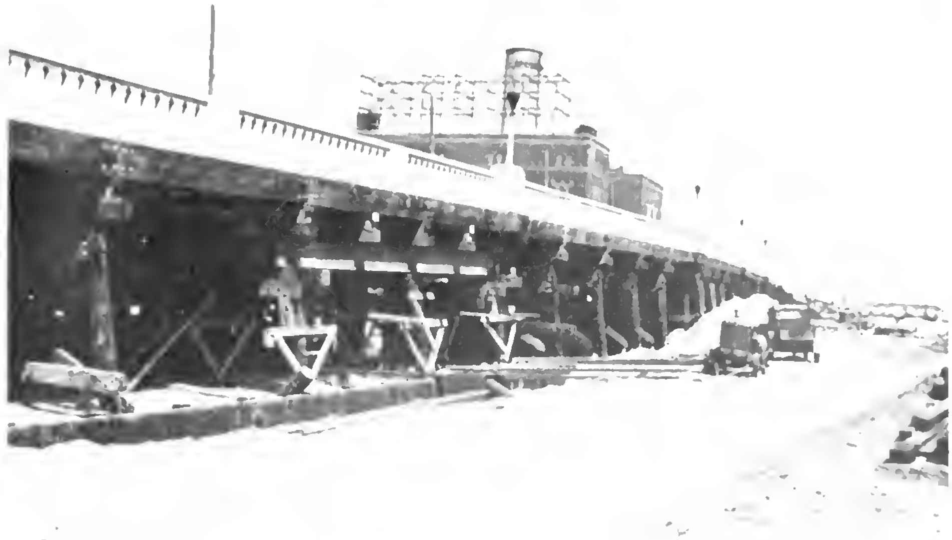
The project under construction by the Department of Public Works includes the building of an 800-foot rock jetty, dredging of Alamitos Bay and new entrance channel paralleling the San Gabriel River on the west side, the moving of two houses from the new entrance channel, the removal of one bent in the Ocean Avenue Bridge and other miscellaneous work.

The Department of Water and Power's project consists of construction of a new intake structure for cooling water for the steam plant, with the inlet end located in Alamitos Bay. The new structure consists of a twin 84-inch pipeline under the San Gabriel River and an inlet structure in Alamitos Bay.

The accompanying pictures show how the project is progressing.

Picture No. 1—West side of Alamitos Bay jetty. The view is southerly from Ocean Beach. The jetty was constructed between January 19th and April 18, 1944. The rock used was hauled by truck from Riverside.

Picture No. 2—Shows 12-foot sections of 84-inch precast reinforced concrete pipe ready to be laid under the San Gabriel River to supply cooling water from Alamitos Bay to the Seal Beach Power Plant of the Los Angeles Water and Power Department. The pipe was temporarily stored on the east bank of the river awaiting delivery to the cofferdam, 400 feet up stream, where it will be finally placed in two parallel lines in a pile-supported concrete cradle. Each section of pipe weighs approximately 21 tons. The view is southwesterly from south side of Ocean Boulevard, showing jetty under this contract in extreme background. The area lying between the visible jetties will form the new entrance to Alamitos Bay. The excavation of an entrance channel through this area is a part of the Shannahan Brothers contract.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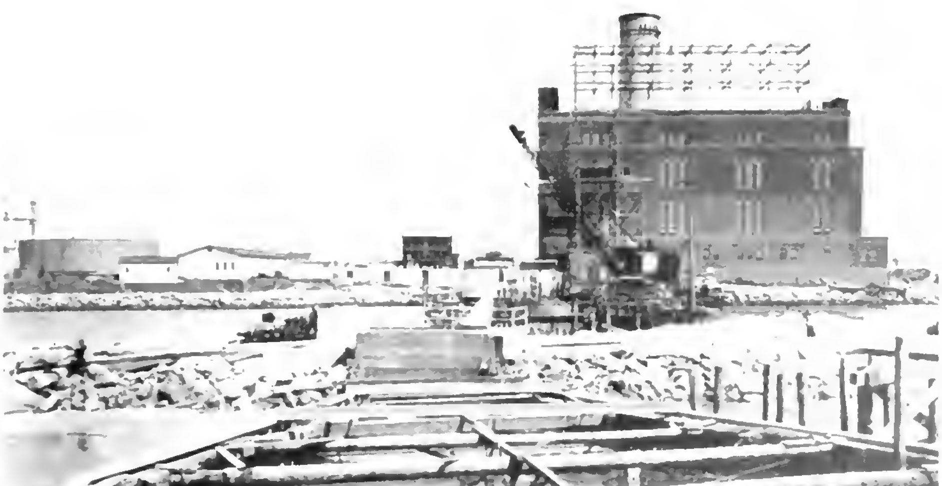
Picture No. 3—Ocean Avenue Bridge showing 27½-inch steel girders installed on new caps on bents 8 and 10. The piles of bent No. 9 had not been removed when this photograph was taken and were being temporarily utilized as stalls until all permanent shims have been placed and angles installed and bolted. The purpose of enlarging this span was to give a larger waterway for yachts and to allow sufficient room for moving a dredger in and out of the bay.

Picture No. 4—Entrance structure to cooling pipe tunnels under San Gabriel River. The central portion of the structure is in course of construction within caisson. The steam operated crane on the construction trestle is placing concrete grillage. Seal Beach power plant in background. Partially constructed levee of the Los Angeles County Flood Control District enveloping concrete stop log chamber is shown across the center portion of the picture. The view is easterly from Alamitos Bay side.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Picture No. 5—View southwesterly from a point near east end of Ocean Avenue Bridge, showing successively from foreground: The mouth of San Gabriel River, west jetty of San Gabriel River, area through which new entrance channel to Alamitos Bay will be dredged, and new jetty in background. In the area to be dredged between the two jetties may be seen the accretion of sand and also the borrow pit from which approximately 19,000 cubic yards have been removed and delivered to Ocean Beach near Granada Avenue.

Picture No. 6—View southwesterly from Ocean Avenue Bridge. Guy F. Atkinson Company is placing concrete in caisson for grillage in middle section of concrete pipe cooling water tunnels being constructed under the San Gabriel River. In the mid picture over caisson may be seen the existing entrance to Alamitos Bay. This entrance will be closed upon completion of the contract between the Los Angeles County Flood Control and Shannahan Brothers, Inc., shortly after the completion of a new entrance channel connecting the bay directly with the Pacific Ocean. This latter work is now under contract with the Department of Public Works, Division of Water Resources, and Shannahan Brothers, Inc.

BIDS CALLED

Bids for the three parts of the project were called for at the same time on November 23, 1944, by the Department of Water and Power, the Los Angeles County Flood Control District and the Department of Public Works; and a contract was awarded by the Department of Water and Power to Guy F. Atkinson Company, while Shannahan Bros., Inc., were awarded contracts by the Los Angeles County Flood Control District and the Department of Public Works.

Construction on the contracts of the Department of Water and Power and the Department of Public Works was started during December, 1943, but heavy storms and flood waters of the San Gabriel River in February and March, 1944, caused delay in prosecuting the work. Construction on the Los Angeles County Flood Control District contract was started in April, 1944. The Department of Public Works contract was approximately 70 per cent completed on September 1, 1944.


5

The rock jetty has been practically completed, bridge alterations made, houses moved and dredging operations have been started.

Guy F. Atkinson Company, contractor for the Department of Water and Power has completed approximately two-thirds of the intake structure. Shannahan Bros., Inc., contractor for the Los Angeles County Flood Control District has completed the levee construction from Ocean Boulevard Bridge to a point immediately upstream from the intake structure inlet. The remaining section of levee which will close off the present entrance channel to Alamitos Bay will be constructed upon completion of dredging of the new entrance channel.


6

HIGHWAY TRANSPORT MUST FIND JOBS FOR 8 MILLION

To hold up its end in meeting postwar employment demands, highway transportation alone will have to provide about one million more jobs than it has ever done before, according to studies of the American Road Builders' Association, announced by Charles M. Upham, Engineer-Director.

"Such an increase would swell employment in highway transportation to approximately eight million workers," Upham pointed out.

"Prior to the war, highway transportation, which includes automotive and accessory production, employment in garages, salesrooms, filling stations, bus and truck drivers and highway construction and maintenance workers, totaled approximately seven million, or about one-seventh of all people gainfully employed. Authorities are in general agreement that the postwar labor force will total approximately 56 million and that jobs must be found for from nine to ten million more workers than were employed before the war."

Position of State Respecting Public Rights in Highways Is Sustained by Appellate Court in Stockton Subway Case

The Supreme Court of California, on July 20, 1944, refused to grant a hearing in the case of *Beckham et al. vs. City of Stockton and State of California, Department of Public Works.* As a result, the decision of the District Court of Appeal, Third Appellate District (64 A.C.A. 591), favoring the State, is now final.

The facts in this important litigation are shown by the map above, reproduced from an exhibit introduced at the trial in the Superior Court of San Joaquin County. The shaded parcels of land indicated on the map are the properties of the plaintiffs which abut upon East Worth Street in Stockton. The subway which caused the alleged damage to their right of access was built in Wilson Way. Presiding Justice Annette Abbot Adams, in her opinion, said that plaintiff property owners' situation resolved itself into "mere circuity and inconvenience of travel after reaching Wilson Way" which, it was held, constituted "no grounds for recovery of damages."

The judgment of the superior court allowing damages was reversed.

The case was tried and the appeal conducted by attorneys for the Department of Public Works.

State Builds Military Roads in Napa and Solano Counties

(Continued from page 9)

sonnel employed on Mare Island has increased over prewar figures from 800 per cent to 1,000 per cent and still more workers are being constantly solicited. It is impossible to house all of these workers in the immediate area and the Navy has as a result instituted a fleet of some 357 Navy buses for the sole purpose of transporting employees to and from this area from Alameda and Contra Costa counties, San Francisco, Marin, Sonoma, and Sacramento counties. This system of buses has created problems in itself in the breakdown of the main traveled highways and streets traversed by the local commute buses of the area.

Access projects of the nature herein discussed are always subordinate to the main construction effort of the military establishments, which with their higher priorities for labor, materials and equipment, tend to increase the difficulties of accomplishment on our subordinate projects. Entirely aside from the primary war construction activity of the Arsenal and the Navy Yard, there

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New $5,000,000 Aliso Street Viaduct Heralds Era of Freeway Construction

WITH FEDERAL, State, county, city and transportation officials participating, colorful ceremonies dedicating the new $5,000,000 Aliso Street Viaduct and the Ramona Freeway across the Los Angeles River were held in Los Angeles on August 15.

Using a pair of five-foot shears, Mayor Fletcher Bowron clipped a rope of asters stretched across the overhead structure, thus opening the viaduct for traffic.

"Acting not merely on behalf of the City of Los Angeles, but of all people who will cross and recross this span for generations to come, I dedicate the Aliso Viaduct to the very greatest and highest use—the use of the American people," Mayor Bowron said, as he severed the flowered ribbon.

Harrison R. Baker of Pasadena, member of the California Highway Commission, represented Governor Earl Warren, whose wartime duties prevented his attendance.

"This great Aliso Street Bridge," Baker said, "is a monument to the foresight and skill of the engineers, the builders and the officials who conceived and constructed the project. It is also a fine monument to the ability of the various agencies involved, including the City of Los Angeles, the County of Los Angeles, the Federal Agencies, the State of California, and the railway companies, to cooperate together in the planning, the financing, and the construction necessary to bring this project to a successful completion.

"However this structure is more than a monument. It is a symbol of greater things to come in the future. This will be the major Eastern gateway to the center of Los Angeles. The Aliso Street Viaduct is the cornerstone of the two master freeways which will join together and enter the Civic Center and central business area at this point—the Santa Ana Parkway and the Ramona Parkway, the first unit of which has just been completed at a cost of $1,208,000 and is being opened today. Thus this new bridge is a symbol of the great freeway system of the future for the Los Angeles metropolitan area.

Governor Warren Sends Greetings To Los Angeles

On the occasion of the dedication of the Aliso Street Viaduct, it is a pleasure to extend greetings and congratulations to the City of Los Angeles and to the County of Los Angeles.

This $5,000,000 project is an excellent example of what cooperation between the State and local political subdivisions can accomplish in the development of our great California Highway System. The Arroyo Seco Parkway is another outstanding monument to this sort of cooperative effort. I think the State may be justifiably proud of its contribution of $746,123 to this undertaking.

The Aliso Street grade separation is another long step forward in solving vehicular traffic congestion in the downtown area of Los Angeles. Over the viaduct will flow a huge volume of such traffic from the proposed Ramona Parkway and the Santa Ana and Hollywood Parkways, both of which are on the postwar program adopted by the California Highway Commission.

Recognizing the future needs for freeways in large metropolitan centers, the Highway Commission is giving much study to this type of highway development and the Aliso Street Viaduct is a component part of its planning in this direction.—*Earl Warren, Governor of California.*

"Recent figures show that California has now become the third largest State in the Union in population. With this growth has come great congestion of population in our metropolitan areas with increasingly difficult problems of urban traffic congestion. This problem is particularly acute in the Los Angeles Metropolitan area.

"The California Highway Commission has taken cognizance of this problem and has allocated a substantial portion of the postwar highway program to the Los Angeles area, with particular emphasis upon the construction of freeways on the State highway system in this section of the State. This means a definite start upon the program of the development of the much needed freeway system in the Los Angeles area.

"California has been built by men who have had faith, courage and vision—by men who have not made small plans. Let us hope that this bridge, which we are dedicating here today, will prove to be a symbol—a symbol of the future—a cornerstone of the freeway system ultimately to be built commensurate with the needs and the importance of the great Los Angeles metropolitan area.

"Included in the postwar program of the Highway Commission for this section are such vital freeway units as the extension of the Arroyo Seco-Harbor Parkway to Fifth Street and the central business district of Los Angeles, the initial unit of the Hollywood Parkway to serve the western portion of the city and the San Fernando Valley, and the building of the first stage of the Santa Ana Parkway from the Civic Center across the Aliso Street Bridge and through the congested East Side section."

The Aliso Viaduct, approximately 3,132 feet long, extends from the westerly approach, near Brooklyn Avenue, to the connection with Ramona Freeway at the old Mason Street Bridge. The concrete arch carries traffic across the Los Angeles River and a network of railroad tracks along both banks. Groundbreaking ceremonies for the project were held November 6, 1939, and work was started with $2,718,000 in Federal WPA funds. The State contributed $746,000 in highway funds and Los Angeles City, Los Angeles County, and the Santa Fe, Union Pacific, and Pacific Electric companies contributed the remainder.

ecently completed $5,000,000 Aliso Street Viaduct across Los Angeles River in Los Angeles, showing [illegible] important freeways

CALIFORNIA MISSIONS

(Continued from page 6)

his wounds. Determined to teach the Indians a lesson, the soldiers killed a number of them with their muskets and for the first time the natives learned that the firearms of the strangers were deadly.

Father Serra continued his friendly overtures to the Indians. Meanwhile, Governor Portola and his expedition had failed in their quest of Monterey Bay and returned discouraged to San Diego on January 25, 1770, to find only 20 members of the mission force alive and food stores almost exhausted. He announced his intention of returning to Mexico with ships and men and abandoning California if the San Antonio with fresh supplies did not arrive by March 19th, the day of the feast of St. Joseph.

PRAYER ANSWERED

Father Serra was heartbroken and declared that he and Father Juan Crespi would remain alone to carry on their work. He prayed day and night for the arrival of the San Antonio. Providentially, on March 19, the day before Portola was to depart, the sail of a ship was sighted far out at sea. Although the vessel proceeded past the harbor and disappeared, Father Serra was overjoyed. Four days later the San Antonio put in, having been forced to turn back on her way to Monterey by a shortage of water. In this incident, Father Serra saw the hand of God.

Confidence was restored to Governor Portola and on April 16th a sea expedition including Father Serra started for Monterey and the following day Portola with a land force again set out in search of the northern bay.

In July, 1771, Father Serra sent Father Luis Jayme from Monterey to San Diego to assume charge of the mission. The latter with Father Francisco Dumetz and later, Father Vincent Fuster, carried on bravely but early in 1772, with the missionaries subsisting on a half pint of corn, 20 ounces of flour and a little milk daily, the situation appeared hopeless. Hearing of the plight of his colleagues, Father Serra in Monterey ordered provisions sent to them and on September 16, 1772, himself arrived at San Diego. Conditions improved and Father Serra in October set sail for Mexico to submit to the viceroy and the College of San Fernando his plans for mission extension, returning to San Diego in March, 1774. He found the mission thriving and approved its removal to a new site about six miles up the valley of the San Diego River. He then continued on to Monterey.

MISSION PROSPERS

The new mission prospered and by 1775 had 97 Christian Indians enrolled. On October 3, 1775, Fathers Jayme and Fuster baptized 60 Indians. But that night, two of the converts left the mission, aroused the natives by telling them that all were to be baptized by force and 800 armed savages stormed the mission, killing Father Jayme, Jose Arroyo, the blacksmith, and Ursulino, the carpenter, looted the chapel and buildings and then set them afire.

Captain Rivera hastened to San Diego from Monterey with troops, and the ringleaders were seized and flogged over the protests of Father Fuster. Owing to strained relations between the missionaries and the military over this incident it was not until the arrival of Father Serra from Monterey in July, 1776, that actual rebuilding of the mission was started and it was not until 1780 that it was completed.

Now began an era of prosperity and fruitful work for the missionaries. In September, 1808, construction of a new church was launched. It was dedicated November 12, 1813, and its ruins stand today. In 1834, the mission was secularized and passed into the hands of a parish priest. From the date of its founding in 1769 to its secularization, 6,638 persons were baptized, 4,428 persons buried, and 1,106 couples married.

After its secularization, Mission San Diego de Alcala fell upon evil days. In June, 1846, Governor Pio Pico of California sold it to Santiago Arguello for past services to the government. American troops were quartered there during the Mexican war and it was a military post until 1858. Thereafter, it was neglected and its walls began to crumble. In 1862, President Lincoln signed an executive order returning it to the Catholic Church. After 20 years of untiring efforts on the part of Albert Mayrhofer of San Diego, the mission was restored to its original form in 1931 and now is open to the public as a museum and lasting monument to its founder, Junipero Serra.

Mission San Diego de Alcala is 7 miles from Fifth and D Streets in San Diego. Leaving from that point by auto, the mission visitor will pass beautiful Balboa Park. The route is past Balboa Park out Park Boulevard, Adams Avenue and Ward Road direct to the mission.

Entering San Diego from the north, motorists using the main State Highway, Route 101, travel over the new Rose Canyon road to the outskirts of Old Town, turn left to Taylor street, then north on Taylor to Camino Del Rio, which leads direct to the mission. The route is along the course of the San Diego River through beautiful rolling country. The visitor may stop at Ramona's Marriage Place and Serra Museum at Old Fort Stockton before proceeding on Camino Del Rio.

Motorists from San Joaquin Valley points may take the Inland Route from Los Angeles, U. S. 395, direct to the mission. Arizona and Imperial Valley visitors will follow U. S. 395 route along El Cajon Avenue to Fairmont Avenue, north to Camino Del Rio and then west to Ward Road and the mission.

Mission bell guide posts along El Camino Real, the State highway, from San Diego to Sonoma direct visitors to all the missions. The first of these directional signs stands in front of Mission San Diego de Alcala and bears the following inscription: "Erected by Mr. and Mrs. A. S. C. Forbes, in memory of Fray Luis Jayme, the first martyr of California. Fr. Jayme was massacred by the Indians November 4, 1775. The bell was blessed and christened 'Jayme' by Rev. J. C. Mesny."

Next—Mission San Luis Rey de Francia.

Two men look out through the selfsame bars; one sees the mud, the other the stars.—*Frederick Langbridge.*

There is no greater obstacle in the way of success in life than trusting for something to turn up, instead of going to work and turning up something.

State Builds Military Roads in Napa and Solano Counties

(Continued from page 17)

ıas been continuous construction of ıew facilities within each of these imortant units which has had first call ıpon the commercial output of fill maerial, base material, and both asphalt ınd concrete paving materials at all imes, although we have had a high deree of cooperation from both Army ınd Navy officials at all times, since oth realized the importance of our work to their effort.

DEARTH OF MATERIALS

There is also a general dearth of high quality base materials, other than commercial, in this area which has resulted in commercial plants carrying the heaviest possible load seven days a week around the clock and still being unable to meet the tremendous demand placed upon them. This incidental but major construction particularly of the Naval Base has, in addition to the traffic difficulties of the bus commuting program, resulted in constant construction trucking over the highways and roads of the vicinity, greatly intensifying the maintenance problem. This has been difficult for the State but even more difficult for the local communities whose gas tax funds have not been augmented by other taxable income, except in very minor degree, due to the tremendous Government holdings of the vicinity. This factor has undoubtedly been recognized in the projects sponsored by the Army and Navy agencies as access projects and discussed herein.

The first project sponsored by the Army involved the relocation of the highway between Benicia and Cordelia. The original highway is located through a portion of the Benicia Arsenal grounds which had to be utilized for military installations. The Government acquired some 13 parcels and Solano County obtained five parcels of right of way on this project. The construction supervised by the district involved heavy two-lane grading and surfacing including two major concrete bridge structures. Since its completion the Arsenal has constructed under permit another major concrete structure utilized as an underpass by the Army in expanding its facilities. We have no record of its cost.

In Memoriam


John Wesley Howe

KNOWN and beloved in newspaper circles on both the Atlantic and Pacific coasts for almost half a century, John W. Howe, Editor of California Highways and Public Works magazine, the official publication of the State Department of Public Works, died on August 29th at Sutter Hospital in Sacramento after an illness of two months.

Born in New York City, September 19, 1876, Mr. Howe attended the public schools of New York and graduated with a B.S. degree in science from the College of the City of New York in 1897. He immediately entered newspaper work. He rose rapidly in his chosen profession. He became one of William Randolph Hearst's trusted executives and served as city editor of the New York Journal and the New York American.

In September, 1915, Mr. Howe was transferred to the Los Angeles Examiner and was automobile editor of that newspaper from September, 1915, to March, 1931.

On September 22, 1931, he was appointed secretary of the California Highway Commission by the late Governor James Rolph, Jr. He combined the work of editing California Highways and Public Works with his duties as Highway Commission secretary until December 15, 1934, when he was named Public Information Editor of the Department of Public Works.

It was during the years of Mr. Howe's editorship that the Public Works magazine became one of the outstanding publications of its kind in this country and at the outbreak of the present war was being mailed to governmental agencies, engineers, universities, and libraries in almost every country in the world.

A lover of music, Mr. Howe was a member of and sang with Sacramento's famous McNeill Club and until his last illness was a member of the choir of the Pioneer Congregational Church.

He is survived by his widow, Mrs. Bertie Howe, his daughter, Mrs. Wayne Rapp of Sacramento, his son, Sergeant John Wesley Howe, Jr., U. S. Army, Santa Ana, California, and a sister, Miss Betty Howe.

BENICIA ARSENAL PROJECT

The second project was initiated by the Navy in improving a number of streets off the highway system, serving a large parking area constructed by the Navy, from plans prepared by the district, adjacent to a ferry approach to Mare Island.

The third project had been initiated by the Benicia Arsenal authorities in late 1940. It involved the four-lane construction of M Street in Benicia entering the Arsenal gates and the widening and reconstruction on partially revised location of the two-lane State highway from Benicia to US 40 at Vallejo. Through a misunderstanding the State was under the impression that the Government agents would acquire the rights of way on this important project as they had on the shorter project through the Arsenal, cited first above. They had requested and been furnished with deed descriptions and preliminary appraisal data. Upon Federal approval of this project in late March, 1942, however, the Government announced that the State was to acquire all rights of way, which involved some 157 parcels, and at the same time expected almost immediate start of construction.

Through concentrated effort toward obtaining immediate rights of entry without condemnation, and through the cooperation of Judge O'Donnell of Solano County, we were enabled to take bids on this important project by May 13, 1942. The low bid appreciably exceeded the estimate and allotted funds. At the request of the Public Roads Administration and through the cooperation of the contractor and the San Francisco office of the Associ-

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Access Defense Highway Construction in District XI

Through the cooperation of the Consolidated Vultee Aircraft Corporation and the Defense Plant Corporation three pedestrian overpasses and one major vehicular overpass have been installed at no construction expense to the State or city. These structures and the major improvements to Pacific Highway have assisted greatly in relieving the congestion and in making it possible to handle the heavy increase in service which has been demanded of this highway.

HARBOR DRIVE WIDENED

Harbor Drive in San Diego, extending from Rosecrans Street, West of the Naval Training Station, to National City, is a new four lane divided highway with several major structures which has been located along the waterfront. It has already become a heavily traveled thoroughfare, serving many military and defense activities, and is now serving approximately 10,000 vehicles per day, which would otherwise be forced to use the overcrowded Pacific Highway.

Mission Valley-Rosecrans Highway in San Diego has provided a much needed modern east-west four lane, divided highway, connecting military and naval establishments with intersecting highways to the north and east, and also providing access to defense plants and housing projects.

A new four lane divided highway extension in San Diego leading to the east from Pacific Highway and connecting with Washington Street and with Douglass Street by means of a highway grade separation, is now under construction, and will provide needed access from the residential area to the defense activities along the waterfront.

OTHER [illegible]

Connections have been built from existing State highways in the county to the large Marine training center at Camp Pendleton, and more recently to Camp Elliott and Camp Callan.

Access roads and a bridge have been provided for Camp Lockett.

Airports, training camps and defense activities in Imperial County have also been served with new or reconstructed access roads.

Under Federal restrictions practically no new highway construction is permitted other than access defense

(Continued on page [illegible])

San Diego highway improvements. Upper—Harbor Drive South (U. S. 101) near Twenty-eighth Street. Center—Miramar Road Access improvement, near U. S. 101. Lower—New Pacific Highway in San Diego

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ated General Contractors, sand piles planned for a peat marsh section were eliminated for which the contractor reduced his grading unit prices and it was possible to finance and award the contract without delay.

PROBLEM SOLVED

March, 1942, was the end of a period in which our maintenance forces had been struggling, largely in vain, to maintain the important Sears Point State highway route between the Vallejo area and the Napa County boundary, a distance of some 11 miles. Similarly, difficulty was being experienced in maintaining the deck of the trestle approaches of the bascule bridge over the Napa River on this road. This problem had resulted from the constant stream of construction trucks entering Mare Island from both directions, but particularly from the Vallejo end on a 24-hour-a-day basis, this total varying from 4,000 to 8,000 trucks per day.

A conference was held with the Navy officials toward providing a solution for the problem, which resulted in the certification of the Sears Point road for its entire length within Solano County from the junction with US 40 to the Sonoma Creek bridge at the Napa County line. The section from Vallejo to the Mare Island entrance was an expedite matter and at the request of the Public Roads Administration, informal bids were taken upon plans rushed to immediate completion.

This contract called for paving of two lanes of concrete for the 2.25 miles involved, excluding the Napa River bridge which was to be made a separate contract. It was started in mid June, 1942, but before completion, per instructions from the PRA, the contract was extended first 0.35 mile to a second entrance to Mare Island and was subsequently extended to the Sonoma Creek bridge, an additional distance of some seven miles. This latter section involved construction over the subsiding tide lands of the area on the existing two-lane road bed where a six-mile detour on adjacent levees on private property presented the major construction difficulty. We fortunately had splendid cooperation from the owners and the paving of this rush project was completed and it was opened to traffic in early January, 1943.

BRIDGE PROJECT

In the meantime, after rejecting first bids for the Napa River Bridge construction, a contract was awarded in August, 1942, for the redecking of the 0.41 mile of the existing bridge. This required the construction of a temporary trestle approach on each end for maintaining traffic during the placing of a new concrete deck upon the trestle approaches of the bridge proper. The contractor and the Bridge Department ran into almost every conceivable difficulty and delay in obtaining materials, and in repairing the bridge which was damaged several times by river and highway traffic during this construction project.

The District and Bridge Department had rushed plans on the Sears Point road between Vallejo and US Route 40, which included a grade separation structure as a part of the road project at the junction of these two important highways, widening throughout, and revisions in existing alignment requiring acquisition of rights of way for the entire length of the project. Obtaining rights of entry were again resorted to, and we were able to get construction under way by May, 1943.

Due to the rapid deterioration of the streets of the vicinity and the approaching winter season, the Navy requested the certification in late 1942 of four sections of arterial streets. To expedite construction the district rushed

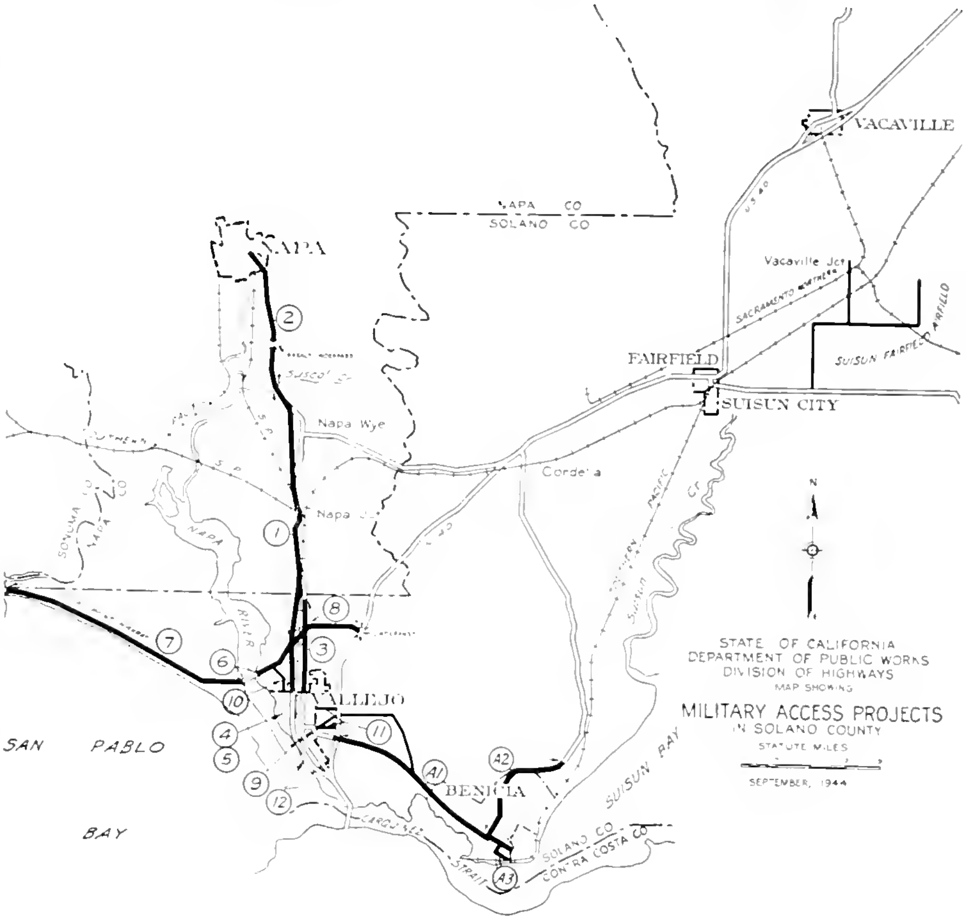
Carryalls engaged in grading on Vallejo-Napa highway between Napa Wye and Vallejo. Paving on this stretch is now nearing completion out plans for three contracts: (a) Sacramento Street, (b) Tennessee and Georgia streets, and (c) Solano Avenue, and was able to get the base placed before winter, completing the surfacing in the spring of 1943. The latter contract involved opening up a section of new street upon an existing right of way. All three contracts involved drainage, base and surfacing two lanes. The county subsequently widened to four lanes Georgia, Tennessee, and portions of Solano Avenue, contributing to the cost.

VALLEJO-NAPA PROJECT

The district had likewise been rushing plans for the most important project between Vallejo and Napa which had been certified in late 1942. This involved many attendant problems in connection with rights of way, particularly with the San Francisco and Napa Valley Railroad, which is the only railroad entering Mare Island proper and which parallels a highway route immediately adjacent to same for some three miles in Solano and Napa counties. Difficult problems were involved also in connection with the Southern Pacific depot and the San Francisco and Napa Valley Railroad depot at the Napa end of the project.

The Basalt Rock Company, desiring to construct an underpass, segregating its cross truck traffic from the quarry on the east side of the highway to its rail and water shipment facilities on the Napa River and also its shipyard located at this point on the Napa River, offered to pay the entire cost of constructing such an underpass in connection with this project. This involved a revision in the grade line of both the existing two-lane road and the two new lanes of concrete to be constructed as a part of the access project. Through a very high degree of cooperation by the Basalt Rock Company, the revision in grade was made, the Basalt Company assuming the full difference in cost of constructing the highway without the underpass and constructing the revised highway with the underpass. Furthermore, Basalt actually performed the construction work under State supervision of the underpass, and of the complete fill and drainage facilities up to the base of concrete for a 0.5 mile section of road. The aggregate cost of this work represented the total difference in cost, as cited above.

Unfortunately all the problems involved in these various arrangements



delayed the start of any work beyond that time when the Government appointed a Facility Review Committee with other attendant agencies which resulted in the delaying of advertising of any portion of this project until August 4, 1943, at which time bids were taken on the 9-mile section from Vallejo to Suscol Creek. On September 15, 1943, bids were received on the second section from Suscol Creek to Napa, Casson and Ball being the low bidders on both of these projects.

This combined major project from Vallejo to Napa consists of constructing two lanes of concrete pavement throughout. These two lanes are on a revised location, being one side of an ultimate four-lane divided highway from Vallejo to Collins, a distance of 3.7 miles. Similar construction is involved from Kelly Curve to Glass House Curve, a distance of two miles, along the general route followed by the San Francisco and Napa Valley Railroad, which section of railroad had been abandoned.

The remainder of the project consists of two lanes of concrete which with the existing two lanes adjacent thereto form a four-lane divided highway, with the exception of the portion from Bell Avenue to Third Street in Napa, a distance of 0.8 mile, where a four-lane asphalt concrete city street section has been utilized.

SPLENDID COOPERATION

To provide for the Navy commuter buses on their local runs, the Navy requested major repairs to some 15 miles of both city streets and county roads and including 3¾ miles of existing State highway routes. This work was awarded in three contracts. A one-mile extension was later requested by the Navy and constructed as a part of this work.

The third Army project called for another entrance from Benicia to the Arsenal, where through cooperation between the Army officials, the contractor, and the State, we were enabled to grade a section of the Arsenal grounds and the highway jointly to the mutual benefit of the Army construction project and the access project.

The accompanying tabulation gives detailed pertinent information on the everal projects involved. They are isted in the approximate reverse order f the dates of completion.

No attempt has been made to show he official designation of the highways ince it is felt that it would confuse ather than clarify.

District X is particularly grateful or the very splendid cooperation of lose working relationship held with he Public Roads Administration at all imes. It would have been impossible o prosecute this program, so essential o the war effort, without this undertanding cooperative effort on the part f District 2 personnel of the San 'rancisco office. We received a very igh degree of cooperation from the rmy and Navy, the counties of Solano nd Napa, and the cities of Vallejo, enicia, and Napa, throughout, and ere assisted in getting rush title reports by the title companies of both Solano and Napa counties.

Resident engineers on the various projects were:

A. K. Nulty, on all Army projects and on the Mare Island Ferry approaches, Mare Island parking lot, Vallejo area arterial and city and county streets, for the Navy; R. E. Lapp, on Vallejo-Suscol Creek project, Routes 74 and 8, and through grading on Suscol Creek-Napa project, Route 8; J. E. Burke, Napa River Bridge project; Wayne Davey, representing the Bridge Department on all other major structures; and George Hubbard on all the remaining projects in the Solano-Napa Access program.

Young Wife—Aren't you the same man I gave some biscuits to last week?

Man (at door)—Oh, no, ma'am. The doctor says I'll never be the same again.

ABUSE OF ROAD FUNDS PREVENTED BY MAINE VOTE FOR AMENDMENT

An overwhelming "yes" vote at the State elections in September placed Maine fifteenth in the list of States which have adopted constitutional amendments preventing diversion of motor revenues to nonhighway purposes. The amendment, first approved by the State Legislature, was sponsored by the Maine Good Roads Federation, leading citizens, chambers of commerce, labor groups, motor clubs and other State groups.

In addition to Maine, these States have protected their highway funds: Minnesota, Kansas, Missouri, Colorado, California, Michigan, New Hampshire, Idaho, Nevada, North Dakota, South Dakota, Iowa, Oregon and West Virginia.

Project reference	Location	Contractor	Navy access projects, type of work	Length, miles	Engineering and construction cost	Number parcels	Right of way cost	Date of completion
N 1	Route 74 and 8, Vallejo-Suscol Creek	Casson & Ball	Two additional lanes concrete	8.93	$781,200	57	$[illegible]	Oct., 1944
N 2	Route 8, Suscol Creek, Napa. In above section	Casson & Ball, Basalt Rock Co.	Underpass and roadway adjacent	4.29 mi	484,800	36	59,500	Oct., 1944
N 3	Bus routes off State highway	Lee J. Immel	Base, surface, shoulders	*3.26	*67,300			Sept., 1944
	Bus routes on State highway	Lee J. Immel		3.19	64,700			
N 4	Bus routes off State highway	Piazza & Huntley	Base, surface, shoulders	*4.12	*84,000			Aug., 1944
	Bus routes on State highway			.55	10,400			
N 5	Bus routes off State highway	Piazza & Huntley	Base, surface, shoulders	*4.70	*85,000			J[illegible], 1944
N 6	Napa River Bridge	Trewhitt-Shields & Fisher	Redeck bridge	0.41	280,200			May, 1944
N 7	Sears Point Highway	Heafey Moore Co.	Two lane concrete pavement	9.64	702,700	2	[illegible]	Feb., 1943
N 8	Sears Point Highway	Heafey Moore Co.	Two lane reconstruction and underpass	3.1	204,700	14	36,400	Jan., 1944
N 9	Vallejo Area Arterial, Solano Avenue	Chas. I. Harney	Base, surface, 4 new streets	*1.3	*73,000			May, 1943
N 10	Vallejo Area Arterial, Sacramento Street	E. A. Forde	Base, surface, 4 new streets	*1.5	*56,000			May, 1943
N 11	Vallejo Area Arterial, Georgia Street	A. G. Raisch	Base, surface, 4 new streets	*1.06	*67,000			May, 1943
N 12	Mare Island Ferry Approaches	E. A. Forde	Base, surface, 4 new streets	*0.7	*22,000			J[illegible], 1942
	Mare Island Parking Lot	Navy Yard	Base, surface, 4 new streets		*22,300			May, 1941
	Vallejo Area Arterial, city streets and county roads		Base, surface, 4 new streets		x18,000			
	Totals on State Highway Systems			30.11	$2,595,700	[illegible]	$[illegible]	
	Totals off State Highway System			*16.64	4[illegible]7,300			
	Grand totals Navy Access Projects			46.75	$3,0[illegible]3,000			

Project reference	Location	Contractor	Army access projects, type of work	Length, miles	Engineering and construction cost	Number parcels	Right of way cost	Date of completion
A 1	Benicia Arsenal–Vallejo	Tyler & Parish	Revise location 2 lanes A.C.	*0.42 5.78	*$40,000 57[illegible],[illegible]	157	$[illegible]	Apr., 1943
A 2	Through Benicia Arsenal	Tyler & Parish	Relocation Grade and surface	3.94	322,800	18	Acquired by Solano County and Federal Government	Apr., 1943
A 3	5th-4th Street Benicia Arsenal	Tyler & Parish	New road into Arsenal	1.1	*[illegible]			Mar., 1943
	Totals on State Highway Systems			[illegible].72	$[illegible]	57	$[illegible]	
	Totals off State Highway Systems			*1.52	*[illegible]			
	Grand totals Army Access Projects			11.24	$1,0[illegible]2,7[illegible]			

Summary	Miles	Construction cost	Right of way Parcels	Right of way Cost	Total cost
State Highway	39.83	$3,4[illegible]5,400	2[illegible]	$262,000	$3,758,300
Off State Highway	18.16	[illegible]			6[illegible],300
Grand totals	57.[illegible]	$4,0[illegible]5,700	2[illegible]	$262,000	$4,35[illegible],[illegible]

OTES:

Work on State Highway system unless otherwise shown.

* Work on roads and streets off the State Highway System.

[1] 2.8 miles on present State Highway System to be relinquished to county on final acceptance of

x Includes contribution of $5,000 Solano County funds for supplemental improvement and repair Solano, Georgia, and Tennessee streets

Summer Highway Repair Program Nearly Complete

THE California Highway Commission last spring allocated $4,000,000 for a state-wide highway repair program for the 1944 season. As of October 1st, all scheduled projects, largely consisting of surface repair contracts and including a number of bridge repair jobs, were under way or completed. This photograph shows resurfacing work on U. S. 50 between Tracy and Banta Road in San Joaquin County, which is typical of the summer program in many counties.

Monterey-Castroville-Prunedale Project Provides Modern Highway

(Continued from page 12)

under another contract. During the time this bridge was out, military traffic only used the Southern Pacific Railroad bridge, which had been planked to accommodate vehicular traffic.

TEMBLADERO SLOUGH BRIDGE

(7) This structure consists of a 5-span reinforced concrete slab bridge on concrete pile bents. The overall length is 95 feet with a clear roadway width of 26 feet.

The contract was awarded to Dan Caputo on March 18, 1942, and accepted September 28, 1942.

CASTROVILLE TO ROUTE 2 NEAR PRUNEDALE

(8) This contract was awarded March 13, 1942, to Harms Brothers and accepted on January 11, 1943. The work consisted of grading and surfacing 22 feet wide with 3 inches of plant mixed surfacing on a 6-inch crusher run base. Shoulders, gutters and dikes were bituminous surface treated and a seal coat with screenings was placed on the plant mixed surfacing.

The largest item of construction in this project was roadway excavation, which amounted to nearly 100,000 cubic yards per mile. There were several locations where unstable ground was encountered, the worst of them being at Moro Cojo near the Castroville end of the project. The unstable material was removed and replaced with sand and the embankment overloaded to accelerate settlement.

CASTROVILLE OVERHEAD OVER SOUTHERN PACIFIC RAILROAD

(9) Immediately east of Castroville, the new highway crosses over the main coast line of the Southern Pacific Railroad Company. The contract for the highway overhead was awarded March 31, 1942, to Kiss Crane Company and accepted December 3, 1942.

The structure is a reinforced concrete girder bridge consisting of 5 spans, totaling 196 feet in length and has a clear roadway width of 26 feet. It eliminates a crossing at grade on the old highway.

Resident Engineer G. W. Thompson supervised the bridge projects, and the road contracts were handled by Resident Engineers J. C. Adams, F. C. Weigel and V. E. Pearson.

Highway Bids and Contract Awards for August and September 1944

August 1944

ALAMEDA COUNTY—In the vicinity of lman Street, about 0.5 mile to be graded d paved with asphalt concrete pavement on isher run base. District IV, Route 69. In pendent Construction Co., Ltd., Oakland, 1,288; A. A. Tieslau & Son, Berkeley, $82, 5. Contract awarded to Lee J. Immel, rkeley, $75,012.

ALAMEDA AND CONTRA COSTA UNTIES—Between El Cerrito Hill Over- ad and Richmond, portions only about 1.0 le, to be repaired with plant mixed surfac- :. District IV. A. J. Raisch, San Jose, 3,911; Independent Construction Co., Ltd., kland, $27,860. Contract awarded to Lee Immel, Berkeley, $22,368.

CONTRA COSTA COUNTY—Between ameda-Contra Costa County line and San blo Avenue, about 0.9 mile to be resurfaced th asphalt concrete. District IV, Route 69. e J. Immel, Berkeley, $25,606; Independ- t Construction Co., Ltd., Oakland, $29,202. ntract awarded to A. J. Raisch, San Jose, 1,937.

DEL NORTE COUNTY—Between Route near Smith River and 0.1 mile northwest- ly of Little Mill Creek, about 0.5 mile in ngth to be graded, imported base material be furnished and placed, and a double prime at to be applied. District I, Route 81, Sec- on A. J. L. Conner & Sons, Eureka, $38,- 8. Contract awarded to John Burman and ns, Eureka, $31,846.

HUMBOLDT COUNTY—At Dyerville, out 0.1 mile heavy stone riprap, wire and ck mattress and permeable pile jetties to be nstructed. District I, Route 1, Sections D. Fred J. Maurer & Son, San Francisco, 7,465; Kiss Crane Co., San Pablo, $69,350. ntract awarded to Scheumann & Johnson, attle, $41,100.

KERN AND LOS ANGELES COUN- IES—Between Antelope School and State oute 58, existing surfacing to be repaired ith roadmix surfacing for 16.1 miles. Dis- ict IX. Contract awarded to Phoenix Con- ruction Co., Bakersfield, $13,258.

KERN COUNTY—Between 2 miles west Wasco and 17 miles west of Famoso, out 3.8 miles to be repaired with plant- ixed material and seal coat. District VI, oute 33, Section D. Union Paving Co., an Francisco, $37,105. Contract awarded Griffith Co., Los Angeles, $35,595.

LOS ANGELES COUNTY—On Ridge oute about 1 mile northerly of Frenchmans lat, a concrete lined channel to be repaired ith Class "D" Portland cement concrete. istrict VII, Route 4, Section I. Norman I. adel, North Hollywood, $28,798; Modern uilders Construction Co., Inc., Long Beach, 28,929; F. E. Stearman, Glendale, $33,370; . B. Tuttle, Long Beach, $34,583; Oberg ros., Inglewood, $43,458; P. G. K. Con- ruction Co., Los Angeles, $19,209; Ralph A. ell, San Marino, $51,800. Contract warded to Mittry Bros. Construction, Los ngeles, $25,168.

LOS ANGELES COUNTY—In the city Los Angeles on Lakewood-Rosemead Blvd. Anaheim-Telegraph Road, existing traffic gnal detectors to be moved laterally and aised to level of new pavement. District II, Route 168, Section B. Econolite Corp., os Angeles, $625. California Electrical Vorks, Ltd., San Diego, $660. Contract warded to C. D. Draucker Co., Los Angeles, 555.

LOS ANGELES COUNTY—On Ramona reeway from State Street to Marengo treet, chain link fence to be constructed. istrict VII, Route 26. Cyclone Fence Divi- on, American Steel & Wire Co. of N. J., lendale, $2,371; Pacific Fence Co., Los An- eles, $2,585. Contract awarded to Alcorn ence Co., Los Angeles, $2,337.

LOS ANGELES COUNTY—At Atlantic nd Bandini Boulevards, about 0.1 mile to be raded and widened with Portland cement concrete and plant mixed surfacing. District VII, Route 167. Olympic Contracting Co., Los Angeles, $20,009. Contract awarded to Vido Kovacevich, South Gate, $19,076.

LOS ANGELES COUNTY—Between Solamint and Agua Dulce Canyon Road and between Newhall and Saugus, portions about 0.6 mile in length, rail and wire bank pro- tection fences to be placed and sacked concrete riprap to be constructed. District VII, Routes 23 and 79, Sections BCD,B. Oberg Bros., Inglewood, $39,875; Frank T. Hickey, Inc., Los Angeles, $49,900; Mittry Bros. Construc- tion Co., Los Angeles, $49,950; Norman I. Fadel, North Hollywood, $53,350; C. B. Tut- tle, Long Beach, $55,150; Ralph A. Bell, San Marino, $58,775; Modern Builders Construc- tion Co., Inc., Long Beach, $60,119. Contract awarded to Bonadiman McCain, Inc., Los Angeles, $32,313.

MODOC COUNTY—Furnishing and stockpiling plant mixed surfacing about 16 miles northeast of Adin. District II, Route 28, Section A. Contract awarded to McGil- livray Construction Co., Sacramento, $2,002.

MODOC COUNTY—Furnishing and stockpiling plant mixed surfacing about 4 miles northeast of Adin. District II, Route 28, Section A. Contract awarded to E. B. Bishop, Orland, $1,935.

NAPA COUNTY—Between Vallejo and Napa, a portion of highway to be repaired. District IV, Route 74, Section A. A. G. Raisch Co., San Francisco, $6,916; C. M. Syar, Vallejo, $6,928; Louis Biasotti & Son, San Francisco, $6,979. Contract awarded to E. A. Forde, San Anselmo, $6,745.

RIVERSIDE COUNTY—Near Shavers Summit, 5 bridges to be repaired. District XI, Route 64, Section B. Modern Builders Construction Co., Inc., Long Beach, $9,468; F. E. Stearman, Glendale, $10,713; E. G. Perham, Los Angeles, $10,916. Contract awarded to C. B. Tuttle, Long Beach, $9,149.

SACRAMENTO COUNTY—Near Mc- Clelland Field on E Street between 16th Street and 32d Street, about 2.0 miles to be graded and surfaced with crusher run base and armor coat. District III. McGillivray Construction Co., Sacramento, $52,663; J. R. Reeves, Sacramento, $55,780. Contract awarded to A. Teichert & Co., Sacramento, $42,072.

SAN DIEGO COUNTY—Across Cotton- wood Creek about 35 miles east of San Diego, a bridge to be repaired. District XI, Route 200, Section C. F. Fredenburg, Temple City, $13,739; C. B. Tuttle, Long Beach, $14,115; Modern Builders Construction Co., Inc., Long Beach, $15,411; Ralph A. Bell, San Marino, $20,841; The Contracting Engineers Co., Los Angeles, $20,864. Contract awarded to E. G. Perham, Los Angeles, $12,937.

TEHAMA COUNTY—Furnishing and stockpiling plant mixed surfacing about 2 miles west of Mineral. District II, Route 29, Section B. Contract awarded to Mercer, Fraser Co., Eureka, $2,837.

TEHAMA COUNTY—Furnishing and stockpiling plant mixed surfacing about 5 miles east of Childs Meadows. District II, Route 29, Section C. Contract awarded to Lester L. Rice, Marysville, $2,474.

VENTURA COUNTY—Across Santa Clara River at Saticoy, the northerly trestle and truss spans of the existing bridge to be repaired. District VII, Route 9, Section A. C. B. Tuttle, Long Beach, $67,497; Norman I. Fadel, North Hollywood, $74,915; Oberg Bros., Inglewood, $75,371; Dan Caputo, San Jose, $75,940; J. E. Haddock, Ltd., Pasadena, $78,169; Byerts & Dunn, Los Angeles, $85,- 654; Ralph A. Bell, San Marino, $89,101; Modern Builders Construction Co., Inc., Long Beach, $92,931. Contract awarded to J. & B. Rocca, Stockton, $64,424.

YOLO AND COLUSA COUNTIES—Be- tween Knights Landing and Grimes, about 10.0 miles to be repaired with imported bor- row material. District III, Route 88, Sec- tion A,A. Westbrook & Bing, Sacramento, $48,180; Phoenix Construction Co., Bakers- field, $50,850; A. Teichert & Company, Sacra- mento, $51,602; A. A. Tieslau & Son, Berke- ley, $54,284; Claude C. Wood, Lodi, $51,587. Contract awarded to W. C. Railing, Redwood City, $47,357.

SAN DIEGO COUNTY—Between San Ysidro and Chula Vista, about 1.5 miles to be repaired with plant mixed surfacing and a seal coat applied. District XI, Route 2, Sec- tion F. Griffith Co., Los Angeles, $12,717; Daley Corp., San Diego, $13,266; V. R. Den- nis Construction Co., San Diego, $13,611. Contract awarded to R. E. Hazard & Sons Contracting Co., San Diego, $12,036.

SAN FRANCISCO-OAKLAND BAY BRIDGE—At Harbor Pier 26, the existing automatic sprinkler system to be revised and extended. Viking Automatic Sprinkler Co., San Francisco, $1,500. Contract awarded to Grinnell Company of the Pacific, San Fran- cisco, $1,393.

SHASTA COUNTY—About 1.5 miles west of Burney, a reinforced concrete box culvert to be constructed. District II, Route 28, Sec- tion C. O'Connor Bros., Red Bluff, $7,612; M. A. Jenkins, Sacramento, $7,750; J. P. Brennan, Redding, $9,981. Contract awarded to C. C. Gildersleeve, Willows, $7,534.

VENTURA COUNTY—Between Fillmore and Piru Creek, about 2.9 miles, to be re- paired with plant mixed material. District VII, Route 79, Section C. Southwest Pav- ing Co., Roscoe, $17,737; Oswald Bros., Los Angeles, $20,738; Griffith Co., Los Angeles, $23,008. Contract awarded to Schroeder & Co., Roscoe, $16,955.

September 1944

ALAMEDA COUNTY—Between San Francisco-Oakland Bay Bridge and Toll Plaza, about 0.6 mile to be repaired by surfac- ing with asphalt concrete (passenger lanes). District IV, Route 5. Lee J. Immel, Berke- ley, $23,927; Independent Construction Co. Ltd., Oakland, $25,640; The Fay Improve- ment Co., San Francisco, $26,980; A. J. Raisch, San Jose, $30,965. Contract awarded to The Lowrie Paving Co., Inc., San Fran- cisco, $21,554.

ALAMEDA COUNTY—Between San Francisco-Oakland Bay Bridge and Toll Plaza, about 0.2 mile to be widened with Portland cement concrete pavement (truck lanes). District IV, Route 5. Independent Construction Co. Ltd., Oakland, $16,031. Contract awarded to Lee J. Immel, Berkeley, $13,678.

CONTRA COSTA COUNTY—In the City of Richmond on Garrard Boulevard be- tween Barrett Avenue and Pennsylvania Avenue, about 0.4 mile to be graded, paved with asphalt concrete pavement on crusher run base and penetration treatment to be applied to shoulders. District IV. J. Henry Harris, Berkeley, $46,932; Lee J. Immel, Berkeley, $50,546; Independent Construction Co., Ltd., Oakland, $51,514; Union Paving Co., San Francisco, $53,032; Chas. L. Har- ney, San Francisco, $53,946; A. J. Raisch, San Jose, $64,169. Contract awarded to Macco Construction Co., Oakland, $41,924.

KERN COUNTY—Between San Bernar- dino County line and 1.5 miles north of Inyo- kern, portions only, about 5.4 miles to be graded, blanketed with imported borrow and imported surfacing material, bituminous sur- face treatment to be applied and 2 reinforced concrete slab bridges on treated timber pile bents to be constructed. District IX, Route 145, Section A, C. Griffith Co., Los Angeles, $143,020; Phoenix Construction Co., Bakers- field, $145,482; D. A. Williams and Frontier Construction Co., Whittier, $152,202; Vin- nell Company, Alhambra, $153,386; Mittry Bros. Construction Co., Los Angeles, $160,- 369; Robert A. Parish, San Francisco, $171,-

872. Contract awarded to Clyde W. Wood, Inc., Los Angeles, $108,069.

LOS ANGELES COUNTY—In the City of Los Angeles on Woodley Avenue between the Southern Pacific Railroad and Sherman Way and on Saticoy Street between Sepulveda Boulevard and Valjean Avenue, about 2.3 miles, to be graded and surfaced with plant-mixed surfacing, asphalt concrete and Portland cement concrete. District VII. Schroeder & Co., Roscoe, $66,015; Vido Kovacevich, South Gate, $68,053; Oswald Bros., Los Angeles, $74,198; Tomei Construction Co., Van Nuys, $81,242. Contract awarded to Griffith Co., Los Angeles, $64,343.

LASSEN COUNTY — Furnishing and stockpiling mineral aggregate between Termo and Madeline. District II, Route 73, Section F. McGillivray Construction Co., Sacramento, $14,570. Contract awarded to Harms Bros., Sacramento, $11,750.

VENTURA-LOS ANGELES COUNTIES—Across Arroyo Simi at Simi and across Castaic Creek near Castaic Junction and the culvert at Station 255+06, two bridges to be repaired and a culvert to be constructed. District VII, Routes 9, 4, 79. Sections C, A, B. C. B. Tuttle, Long Beach, $20,150; Norman I. Eadel, North Hollywood, $21,466; Modern Builders Construction Co., Inc., Long Beach, $1,725,538. Contract awarded to F. Fredenburg, Temple City, $18,603.

RIVERSIDE COUNTY—Between Beaumont and Banning at Station 18+76, constructing a reinforced concrete box culvert. District VIII, Route 26, Section B. Matich Bros., Elsinore, $10,289; George Herz & Co., San Bernardino, $9,412. Contract awarded to Egglestone & Root, San Bernardino, $8,539.

SACRAMENTO COUNTY—Repairing a bridge on the State highway across the Sacramento River at Rio Vista. District X, Route 53, Section C. Jas. H. McFarland, San Francisco, $3,454; C. C. Gildersleeve, Willows, $4,720; Barton & Anderson, Oakland, $4,132. Contract awarded to M. A. Jenkins, Sacramento, $3,420.

SACRAMENTO COUNTY—Across the Sacramento River at Rio Vista, a portion of the existing bridge to be reconstructed. District X, Route 53, Section C. C. W. Caletti & Company, San Rafael, $733,481; J. H. Pomeroy & Co., Inc., San Francisco, $745,773; Earl W. Heple, San Jose, $746,680; United Concrete Pipe Corp. & Ralph A. Bell, Los Angeles, $717,375; W. A. Bechtel Co., San Francisco, $755,127; A. Soda & Son, Oakland, $764,984; George Pollock Co., Sacramento, $772,472; Morrison Knudsen Co., Inc., Los Angeles, $812,963. Contract awarded to Lord & Bishop & A. Teichert & Son, Inc., Sacramento, $727,858.

SAN BERNARDINO AND RIVERSIDE COUNTIES—Between Redlands and Beaumont, about 9.4 miles, seal coat to be placed over the existing surfacing. District VIII, Route 2, Sections B, A. A. S. Hubbs, Colton, $8,449; Matich Bros., Elsinore, $7,675; Geo. Herz & Co., San Bernardino, $8,392. Contract awarded to C. R. Herring Co., Los Angeles, $7,190.

SAN DIEGO COUNTY—Between Palm Avenue and Coronado, about 4.7 miles, to be graded, paved with asphalt concrete and Portland cement concrete. District XI, Route 199, Section A, Coronado. Griffith Co., Los Angeles, $247,153; R. E. Hazard & Sons Contracting Co., San Diego, $274,798; V. R. Dennis Construction Co., San Diego, $284,927; Ralph O. Dixson, Alhambra, $300,387. Contract awarded to Basich Bros., Alhambra, $234,229.

SAN DIEGO COUNTY—In the City of San Diego on Pacific Highway between Broadway and Torrey Pines Grade and on Rosecrans Street between Lytton Street and Canon Street, portions only, about 10.4 miles to be repaired by resurfacing with plant-mixed surfacing material, seal coat only to be applied to portions of existing pavement. District XI, Routes 2, 12. Basich Bros. Construction Co., Alhambra, $60,802; R. E. Hazard & Sons Contracting Co., San Diego, $60,922; J. E. Haddock, Ltd., Pasadena, $65,072; Daley Corp., San Diego, $66,178. Contract awarded to Griffith Co., Los Angeles, $54,796.

SAN DIEGO COUNTY — Between I Street in Chula Vista and South Harbor Drive at 7th Street in National City, about 3.6 miles, to be graded and surfaced with plant-mixed surfacing. District XI. Griffith Co., Los Angeles, $170,971; R. E. Hazard & Sons Contracting Co., San Diego, $195,891; V. R. Dennis Construction Co., San Diego, $201,261. Contract awarded to Basich Bros. Construction Co., Alhambra, $158,310.

SAN FRANCISCO-OAKLAND BAY BRIDGE—Repairing struts TS4W and TS4E of Bent E4 of the East Bay Crossing. District IV. Bethlehem Steel Co., Alameda, $18,614. Contract awarded to Columbia Steel Co., San Francisco, $17,977.

SAN JOAQUIN COUNTY—Between 5 miles south of Stockton and 0.6 mile north of Lodi, four timber trestle bridges to be repaired. District X, Routes 4 and 5, Sections G, B. William E. Thomas Concrete Construction, Petaluma, $28,153; Stockton Construction Co., Stockton, $29,540; J. H. McFarland, San Francisco, $32,449. Contract awarded to Dan Caputo, San Jose, $26,319.

Ode To A Surveyor

Pity, Oh pity the man that's inside,
Who has to interpret your notes,
Who has to design, and map, and plot,
And mostly he needs the stuff you forgot,
And the corners you didn't get tied.

Pity, Oh pity the man that's inside,
For mind-reading isn't much fun
When the mind you must read is far, far away,
And the time when it thunk is past many a day,
And the notes hold no hint for a guide.

Is the book nice and white, and the dope in your head,
So the dope has the dope (and his thoughts can't be read?)
Or didn't you know what stuff you should get?
Was the weather too dry, or was it too wet?
Or maybe it's hot, or maybe it's cold,
Or your help is too young or maybe too old.

But don't you forget the draftsman must guess
And a guess, I guess, can be quite a mess.
The tea leaves are failing, the crystal ball's cracked
With trying to find the things the notes lacked.
Oh pity, Oh pity the man that's inside,
Who is just about fit to be tied.

—A. Nonimous Draffsmunn

First Highway Tax Was in Scotland

We can sometimes take lessons from the old-timers. Scotland had a road maintenance tax some 400 years ago. It may not have been the first of its kind, but it was at least almost four centuries older than our modern gasoline tax.

In the early sixteenth century, the Canongate was one of the first paved streets in Edinburgh. It was also the main street of the medieval Scottish capital. Soon after the paving of the Canongate was finished, James V of Scotland in 1535 issued a proclamation governing all traffic on the Canongate. The law applied equally to private and government-owned vehicles.

Empty carts and wagons using the Canongate were compelled to pay a tax of one halfpenny every time they traveled along the street. Loaded carts and other vehicles paid a tax of one penny to "repair and maintain the causeway."

The proclamation of the Stuart King might very well have been the first of its kind. It was certainly the first to lexy taxes in proportion to the amount of wear and tear on a street or highway.

Access Defense Highway Construction in District XI

(Continued from page 22)

highways, however, the heavy demands of wartime conditions have placed unusually heavy traffic, both in volume and weight, on most of the State Highway System and this has resulted in rapid deterioration and failures in the roadway surfaces. To meet that condition temporarily, we have placed approximately 140 miles of light bituminous blankets on the sections most in need of repairs during the past two years.

The district is also engaged on a program of preparing plans for postwar highway projects in line with the policy of the State Highway Engineer to be prepared to do our part in the postwar era.

In connection with a program such as outlined above, entire cooperation of all of the remaining district employees is greatly appreciated. Many of them have worked overtime and outside their usual assignments in order to complete their work.

State of California

EARL WARREN, Governor

Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

CHARLES H. PURCELL, Director of Public Works

A. H. HENDERSON, Assistant Director

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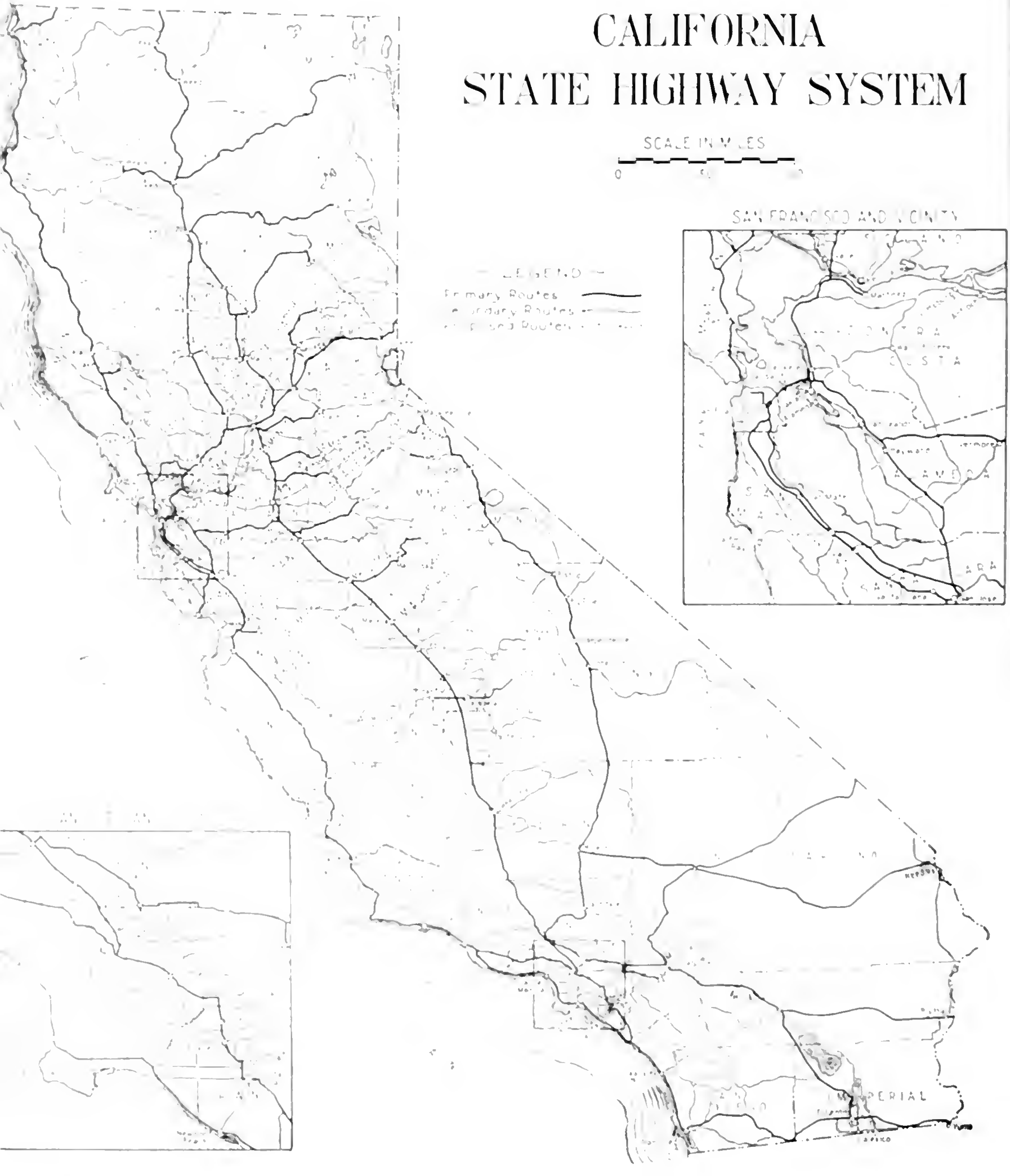

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

NOV.-DEC.
1944

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California [PRINTED IN U.S.A.]

C. H. PURCELL, Director | GEORGE T. McCOY, State Highway Engineer | K. C. ADAMS, Editor

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Vol. 22 | NOVEMBER-DECEMBER 1944 | Nos. 11, 12

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California Highway Commission Adopts Second Wartime Budget Based on $68,000,000 Revenues

THE California Highway Commission meeting in Los Angeles on November 16th adopted its
eond wartime budget.

Budget allocations for the 1945-47 biennium are based on estimated
venues of $68,000,000 for the bien-
al period. State Highway Engineer
eorge T. McCoy informed the Com-
ssion that he anticipates $56,500,-
0 of gas tax income, $8,450,000 of
otor Vehicle fees, $3,000,000 of Use
el tax (Diesel) and $50,000 of
ravan fees.

"The restrictions imposed on motor
ansports by reason of the war and
e lack of any dependable informa-
on with regard to changes in those
strictions, preclude any accurate
timate of revenue to the State high-
ay fund during the Ninety-seventh
d Ninety-eighth Fiscal Years,"
eCoy said.

"From the information available to
at this time it appears that it is un-
kely that there will be any more dras-
restrictions imposed on motor
ansport during the war. It is a fact,
owever, that considering the entire
ation the replacement of motor vehi-
es at this time is not keeping pace
ith the retirement. The effect of this
et loss in motor vehicle units will be-
ome apparent in fuel tax receipts and
egistration fees in due time unless
ore replacement units are made
ailable. There is no accurate infor-
ation as to this net loss in total vehi-
e units available.

"In California the situation is more
definite because of the lack of fac-
al data with regard to movement of
oreign vehicles into and out of the
tate. Information from the Motor
ehicle Department indicates at this
me that the total registrations in
alifornia during 1944 will exceed the
943 registrations by a small margin.

"It appears also at this time that
e restrictions on motor transport
ow in effect will not be relaxed so as to
ermit more travel until after the war.

"The estimate of revenue for the
ext biennium, therefore, is based on a
ontinuation of motor vehicle travel
nd registration at the current 1944
evel."

San Francisco-Oakland Bay Bridge Budget

THE following tabulation shows in detail the estimated cost of operation and maintenance of the San Francisco-Oakland Bay Bridge for the Ninety-seventh-Ninety-eighth Fiscal Years, as set forth in the 1945-1947 highway budget.

The present physical damage insurance on the bridge runs until September 1, 1946, and the premiums have been paid to that date. The insurance premiums heretofore have been paid on the basis of five-year terms. On the basis of the present rates, the premium on a five-year policy is approximately $576,000 and has been paid in advance.

The maintenance and operating costs are on the basis of the continuance of present salaries with normal increases.

The painting of the bridge during the war has fallen well below normal requirements, because of the inability to employ a sufficient number of painters for this work. It is estimated that during the coming biennium it will be necessary to employ, if available, 80 painters, which is approximately 50 more than are being employed at the present time.

		Biennium 7-1-43 to 6-30-45		Biennium 7-1-45 to 6-30-47
Administration (including accounting, general office expenses, and retirement and compensation insurance for all employees)		$252,940		$288,880
Toll collection		394,870		402,900
Ordinary maintenance		229 050		296,450
Painting				
Labor	$116,250		$416,900	
Materials and supplies	15,250		90,000	
New scaffolds	35,000		50,000	
Total painting		166,500		556,900
Tow car and emergency service		83,760		88,870
War damage insurance		54,000		
Total, excluding physical damage insurance premium		$1 181,120		$1,634,000
Premium on physical damage insurance (due September 1, 1946)				576,000
Totals		$1,181,120		$2,210,000

Note.—The premium on physical damage insurance on the San Francisco-Oakland Bay Bridge has been paid in advance to September 1, 1946.

C. H. Purcell, Chairman of the Commission and Director of Public Works, said that tentative budget allocations would be as follows:

Administration, $3,997,762; traffic engineering and special investigations, $352,238; maintenance, $19,470,000, of which $19,420,000 is for general maintenance and $50,000 for the Carquinez and Antioch bridges; highway planning survey, $200,000; new equipment, $417,500; major city streets (¼ cent gas tax allocation), $7,062,500; State highways within cities (¼ cent gas tax allocation), $7,062,500; all other functions, reconditioning, resurfacing, construction, engineering, right of way, joint highway districts, and contingency and reserve $29,437,500.

Under the Breed act, Purcell said, there is set up for primary highways in the north, $9,898,800; and for secondary highways, north, $9,125,000; for primary highways in the south, $8,351,200; and for secondary highways, south, $9,125,000, or a total of $36,500,000. This total includes $7,062,500, the estimated amount of ¼ cent of gas tax for State highways within cities.

The allowance for general maintenance is increased approximately $576,000 and replacement projects $226,000 although the overall increase in the budget is only about $315,000.

"Construction and reconstruction has been at a minimum during the last three years," Purcell explained. "There has been no reduction in the tonnage of heavy loads using the highways, in fact, in many areas heavy hauling has increased. The highway surfacing has reached a condition where either increased continuous maintenance or specific repair is required on a considerable portion of the mileage if the investment is to be conserved. The estimated requirements for major slide removal is reduced $400,000 as compared with the current period. This is a result of reduction in major construction. The opening up of heavy cuts on new work always involves large expenditures for slide removal and correction work for a period of two or three years."

Alameda Access Road to San Leandro Naval Hospital in Oakland. View shows concrete pavement on heavy grade. Hospital building in background

Highway District IV Felt Impact of War

By JNO. H. SKEGGS, District Highway Engineer

FROM the time of the declaration by the President that a National emergency existed until our actual entry into the war on December 7, 1941, the State Highway organization generally and District IV in particular had been in the process of formulating plans for the action that all could see was coming. The war, however, came a little too soon for completion of plans to provide an adequate road service for the tremendous increase of industrial and military activities around San Francisco Bay.

The biggest headache was the Richmond area where that peaceful little city of 21,000 awoke one morning to find a population of about 91,000, with many more thousands employed in the shipyards and other war industries located there. These additional thousands had to find living quarters in Oakland, Berkeley, Alameda or anywhere they could and then get to work by automobile or bus. A scheme for handling the traffic had been tentatively worked out but was still in the "conference and correspondence" stage. Jap bombs crystallized those plans and broke all the red tape.

The primary cure for the congestion of the East Shore Highway traffic (1941 count 37,332) was the construction of the so-called Richmond Access Road from the El Cerrito Hill overhead, on Route 69, to Cutting Boulevard in Richmond. Bids for the first contract were opened in the District office on March 17, 1942 and the contract was awarded to the Macco Construction Company whose bid of $310,800 was the lowest of the seven received.

Advertising and bid opening on that project was, we believe, unique in the history of the Department. By telephone, most likely and best equipped contractors were invited to bid on this pig in a poke involving construction over marsh lands of extremely doubtful character. Specifications were being written and plans were being drawn with neither available to prospective bidders and only six days for them to think it over! The integrity of the department, the contractors' faith in that integrity and an approximate list of items involved constituted the sole basis for bids!

Surveys and plans were done at the same general rate that characterized the advertising and taking of bids and yet were surprisingly complete when studied in the calmer moments after the contract had been awarded and construction started.

That is a sketchy history of the first war-time access road project of the 25 that have been constructed since.

The vital military and industrial nature of the Bay area with its Mare Island Naval Yard, Ports of Embarkation, shipyards, oil refineries, rail terminals, bridges and the myriad other and, perhaps, equally important industries offered a prime target for enemy action by air attack from Jap carriers, especially in view of the disaster that fell on such a large portion of our fleet at Pearl Harbor. Immediately the need for more air bases close to vulnerable points was dictated. Military authorities were busy enlarging existing bases and developing new ones. Their overtaxed resources needed some help so they called upon us to construct a fighter plane base right on the coast near Halfmoon Bay. Construction was started on August

Intersection of East Shore Highway and Gilman Street, showing island in process of construction. Automatic signals will be installed at this point

1, 1942 and a usable 7,000-foot flight trip was ready by February 9, 1943 t a cost of about $460,000.

Types of construction involved in he access road program ran the whole amut from resurface of existing city treets to major highway grading and paving jobs, including reconstruction of a narrow mountain road (Naval Net Depot, Tiburon), new city streets and an airfield. The entire program to date has required construction on, or of, approximately 28 miles of road or street and 7,000 feet of flight strip in 25 projects at a total cost of approximately $3,100,000. Of the total projects, eight are in Richmond or serve that city and they have absorbed one-third of the money spent.

A total of nine access road projects were constructed in Contra Costa

Marin Access Road to Dry Dock Training Center and Naval Net Depot on Tiburon Peninsula. View is looking north

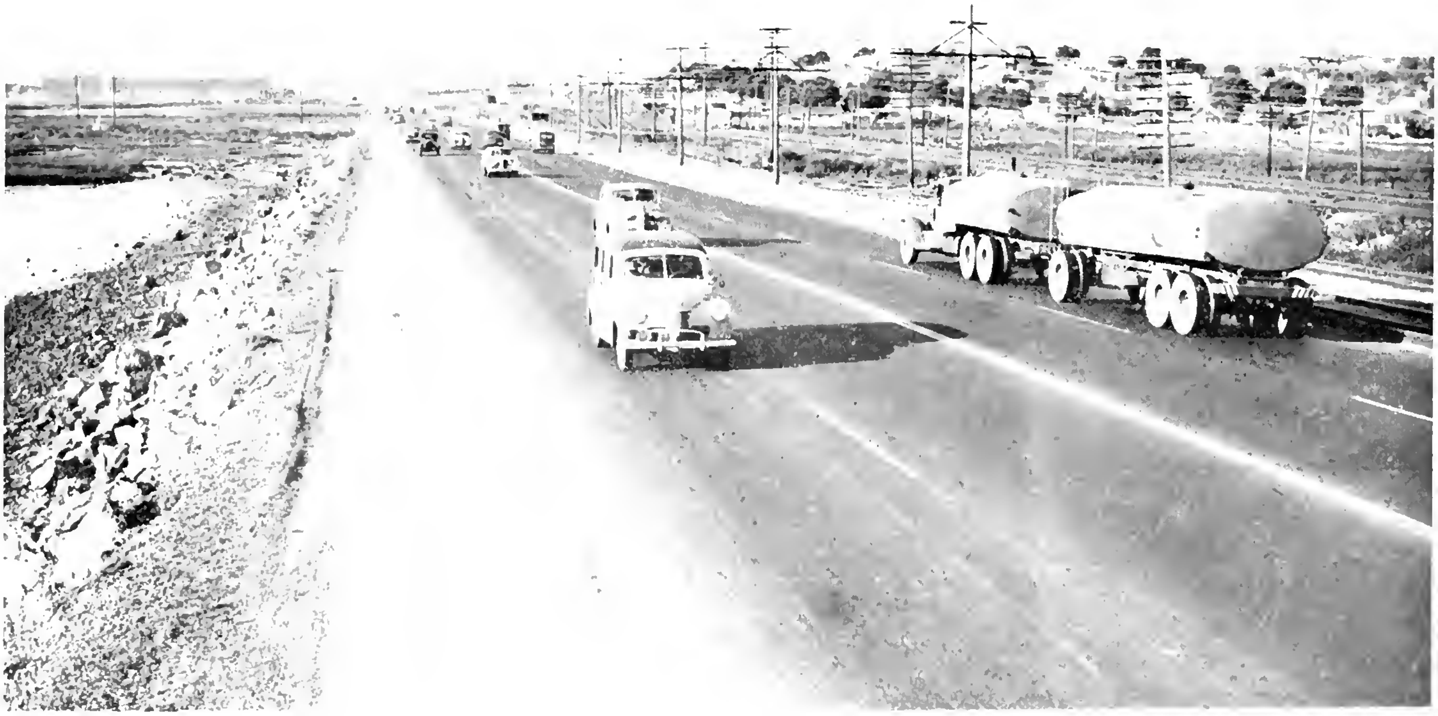
Fourteenth Street in Richmond. Looking north from near entrance to Shipyard No. 1

County. It is interesting to note that that county has experienced a population growth in excess of 100 per cent since 1940 with the increase distributed in a fairly uniform manner over the entire county which embraces many large war industries in addition to those in Richmond. It is believed that the rate of increase is the greatest in the United States.

The expansion of Mare Island Navy Yard required a wide spreading area to house the workers. Nearby Napa County was called on to carry its share, thereby placing an impossible burden on the available two-way highways. It therefore became necessary

(Continued on page 22)

Richmond Access Road. Looking north from El Cerrito Overhead. Construction is across deep marsh. Trolley tracks on right were constructed by the Maritime Commission to serve ship yards. Southern Pacific main line is to the right of trolley tracks



)rigin of Sections, Townships and
₹anges Goes Back to Colonial Days

INTRODUCTION

WE know that there exists in some of the States of the Union, a system of land description unlike that found in the other States, or in any other part of the world. We know that this system is of recent development, and that in the history of modern, medieval, and ancient nations, no similar system ever existed. Since the days of the clay tablet deeds of Babylon, land had always been described by boundaries, and ownerships were irregularly placed. Lands were always settled first and surveyed afterwards. Somebody hit upon the idea that this process should be reversed; that land should be regularly surveyed before settlement, and the settlers be compelled to conform to such survey; and that land descriptions would be greatly simplified, and controversies minimized, by laying out the public domain into a gigantic gridiron of sections, townships and ranges.

Who invented this system? Why was it invented? And where did the inventors get the idea? Why are sections six miles square and why the back and forth numbering? It is believed that the story of this, the first improvement in land plotting since the dawn of history, will prove interesting to Highway Engineers and Right of Way Agents, whose daily work is the handling of these tracts of land.

The accompanying article by Frank J. Cordes is the first of two installments.

BEFORE the American Revolution the colonies had for years disposed of their lands under ›o distinct systems, based on differ›t physical and economic conditions. These two land systems, which were ›eveloped in America during the ›olonial Period, have been called the ›ew England System, and the South›n System.

The New England System was based ›omewhat on the county, town or ›arish systems, which had existed in ›ngland for a long time. There, a ›ownship was an irregular area or dis›iet surrounding a town or village. ›n fact, the district was itself fre›uently called a "town." And in ›ew England we find the settlers fol›owing this custom by laying out ›towns," or townships, where there ›ere no actual towns or villages. ›hese towns (or tracts where they ›oped towns would be), were laid out ›receding private ownership and ›here could be no title to land outside ›town or township. Within the town›hip the land was divided into tracts ›y the colony, or the proprietors. ›hese tracts were definite in amount, ›nd plats were prepared and bounds ›ecorded. Surveys of such tracts ›lmost always preceded settlement.

The towns were responsible for the ›ccuracy of the surveys, and the offi›ers saw to it that the bounds were ›ccurately determined. Townships ›ere sometimes laid out in tiers, or ›anks, or ranges, although usually in ›istant locations. The favorite size ›as six miles square. This, no doubt, ›as because few persons had, at that ›ime, realized the desirable qualities ›f the decimal system. People still ›hought in terms of dozens and half ›ozens. And the townships were not ›arger, because the influence of a vil›age in those days could hardly extend ›ore than a few miles.

FIRST TOWNSHIP INCORPORATED

As early as 1652 we find the town of ›helmsford, Massachusetts, incorpo›ated as a rectangle of 36 square miles ›n 1741 a 12-mile square township was ›et out in Wadchuset. And in 1656, ›arlborough, Massachusetts, was laid ›ut six miles square, although not in a meridional, or north and south, direction. Probably the first six-mile-square township located north and south, was that of Bennington, New Hampshire, established in 1749. Thus gradually during a period of more than a century, New England developed and became strongly attached to its system, the germ of which was the early Anglo Saxon township, or tunscrape, similar, you will see, to landscape. A tun was a tract enclosed in a fence or wall.

The Southern System differed from the New England System in that the land was taken up by location of warrants and concessions, for separated tracts of any size or shape, on any unappropriated land. Surveys were to be made by public surveyors, but were usually executed by deputies of little experience, and errors were frequent. The Virginia System of 1729 called for warrants, caveats, and grants, while the New England System called for a simple deed. The Southern System was also used in North Carolina, as well as in the territories of Kentucky and Tennessee.

TWO SYSTEMS DIFFERENT

The difference between these two systems is apparent. Under the New England plan, protection was provided against overlapping surveys and title disputes; and the town was the guarantor for the accuracy of the survey. This system of "discriminate location" tended toward compactness of a free population, and was a protection against the savages, and a mutual help during the severe winters. Also in New England, the waste land in the local communities was laid out by local committees, and plats were recorded at once to prevent the possibility of overlapping claims. An individual could not horde the best land for himself; the proprietor or townspeople shared in each division of the unappropriated land. This system afforded security of title, and orderly settlement of new lands.

On the other hand, the Southern System required only individual initiative. A person selected a desirable portion of vacant land, and had it laid off by a Government surveyor under his direction. No relation of other pieces of property to his own was shown. This was called "indiscriminate location."

The surveys were often incorrect; recording was carelessly done; natural bounds were used; and this often re-

(Continued on page [illegible])

CALIFORNIA MISSIONS

By KENNETH C. ADAMS, Editor

San Luis Rey de Francia June 13, 1798

WHILE the Mission San Luis Rey de Francia is the second of the 21 Franciscan missions stretching from San Diego to Sonoma in the north, it was the eighteenth one founded.

During the period of its prosperity, it was the grandest of all the missionary establishments in California and was called by Father Zephyrin Engelhardt, noted mission authority, "King of the Missions."

In the early days of the Mission San Diego de Alcala, the need for a station between it and Mission San Juan Capistrano was felt. The distance separating the two could not be covered in a day, which made traveling hazardous, and, furthermore, the overworked Fathers in San Diego often had to go to intervening rancherias to attend upon sick Indians.

The first move to locate a site for a mission between San Diego and San Juan Capistrano was made on July 23, 1795, when Governor Diego Borica sent out an exploring party with which went Father Juan Mariner. The latter recommended the rancheria Pale, but this site was deemed to be too far off the Camino Real and in 1796 Fr. Presidente Lasuen, himself, selected the present site which Father Juan Crespi in July, 1769, passing there with Portola, had reported to be an ideal location for a mission and had named San Juan Capistrano. This place following the founding of Mission San Juan Capistrano, had been called San Juan Capistrano el Viejo, or Capistrano, to distinguish it from the mission of the same name.

TRAGIC HISTORY

On June 13, 1798, Fr. Lasuen formally established the mission. Viceroy Branciforte had chosen the patron saint, St. Louis IX, King of France, hence the name San Luis Rey de Francia. On that same day, the good Father Presidente baptized 54 Indian children. Under such propitious circumstances did the new mission start and on August 29, 1798, Fr. Lasuen proudly reported to Governor Borica that 147 Indians had been baptized and 28 couples married.

The story of San Luis Rey is the most tragic in the history of California missions. It ascended to heights of success and grandeur attained by no other mission and its destruction, brought about by years of strife between the Church on the one hand and greedy civil officials and politicians and the military on the other, remains a blot on the annals of early California.

Under Father Antonio Peyri and his assistants, the mission steadily grew in size and prosperity, these missionaries proving themselves to be great builders. Troubles with the military which began in 1810 would seem to have been prophetic of the end of San Luis Rey. In that year Fr. Peyri several times was forced to complain officially against encroachments upon mission lands by the soldiers and from then on the tribulations of the priests increased.

NEW CHURCH BUILT

During 1810, the Indian population at the mission increased from 1,121 to 1,571 and 432 converts were received. All these had to be fed, housed and clothed and placed in gainful occupations by the Fathers. More accommodations were required and in 1811 Fr. Peyri laid the foundations for a new church, which is the mission of the present day. It was completed and dedicated on October 4, 1815. Meanwhile, a chapel and granary had been constructed at Pala and by 1818 the chapel had been enlarged and another granary built. Improvements continued until 1832. In 1826 some 2,869 neophytes were enrolled at San Luis Rey. Four years before, Father Peyri officially reported that the mission had 20,500 sheep, 12,000 head of cattle, 500 horses and 150 mules.

The revolt in Mexico against Spain in 1810 brought additional grief to San Luis Rey and other missions. No goods for the missions nor pay for the soldiers in California came from Mexico, with the result that the military demanded that the Mission Indians support the soldiers and their families, and furnish equipment and cash payments. Following Mexican independence, Fr. Peyri contributed heavily in money to the territorial government and this drain on the mission increased steadily and rapidly.

Mission Meccas

California's famous old missions with their historical and romantic background annually attract thousands of visitors. Twenty-one Franciscan missions were founded by the Reverend Fray Junipero Serra and his colleagues, extending from San Diego to Sonoma. On his way north from San Diego, Father Serra and the mission padres who came after him followed a course which became known as El Camino Real, "The King's Highway." El Camino Real retains to this day its original name and is designated U. S. 101. Along this highway and short distances from it, the founding padres established their missions. U. S. 101, the old "King's Highway," now extends from the Mexican border into northern Washington.

Present day State highways lead to all the mission sites. When the war is ended and California again welcomes tourists from all over the world and there are no longer restrictions on automobile travel, it is believed that the missions will be popular meccas for visitors to the Golden State.

Anticipating this traffic, the Division of Highways will publish in California Highways and Public Works brief histories of the missions with directions on how to reach them over State highways. For the purpose of this series, the missions will be taken up in the order of their locations from south to north, rather than in the sequence of their founding.

This is the second of the series.

This recent photograph shows the pleasing architectural design of Mission San Luis Rey de Francia, on which considerable restoration work has been done

The ruination of San Luis Rey is placed by Father Engelhardt largely upon the shoulders of Territorial Governor Echeandia and Pio Pico, civil administrator of the mission following secularization of the California missions, and later Governor. He condemns them in language that is strong for a priest.

PADRE HEARTBROKEN

Worn out by his long battle to save his mission and protect his Indians and their lands, Father Peyri, at the age of 70, sailed from San Diego January 17, 1832, for Spain, heartbroken and ill. Tradition has it that 500 of his converts on horseback hastened to San Diego to bring him back, but arrived as the father's ship was sailing. They rode their horses into the sea begging him to return. Peyri took home with him two Indian boys who idolized him.

In December preceding his departure, the official report on San Luis Rey showed that 2,819 Indians lived at the mission under his care, that there were 26,000 head of cattle, 25,500 sheep, 1,200 goats, 2,150 horses, 250 mules and 300 pigs. A total of 5,298 baptisms had been administered, mostly by Father Peyri.

The wealth of San Luis Rey and other California missions excited the cupidity of the Spanish Government and as early as 1813 a decree confiscating all American mission property was issued. This order was not confirmed for seven years and enactment was delayed twelve years longer, at the end of which time the Congress of Mexico issued an edict secularizing all the missions.

MISSION SEIZED

On July 15, 1833, Governor Figueroa ordered all qualified neophytes at San Luis Rey freed from missionary control, publishing his Regulations for the Emancipation of the Mission Indians, and on August 9, 1834, directed seizure of all the property of the mission. Formal confiscation was completed when the mission was surrendered to Pio Pico and Pablo de la Portilla, commissioners named by Governor Figueroa, on August 22, 1835.

The civil government took over the mission buildings, church, all property, including sacred vessels, vestments, etc., and six ranches owned and operated by the padres and their Indian converts. The total value of the property seized was placed at $203,737.37, and outstanding debts were listed at $9,300.87.

On this date the death knell of Mission San Luis Rey was sounded. Salaried administrators took complete charge. Through the terms of a succession of such administrators, the mission padres bravely tried to protect the rights of the Indians and endured with them the hardships and starvation that followed civil control. The missionaries who had been founders and guardians of the mission and the neophytes became mere tenants and barely were tolerated as such.

Many of the converts fled to the mountains and reverted to their savage ways. Others refused to work and became shiftless and troublesome. Those who remained with the mission became little more than slaves.

"Such at this time," says Father Engelhardt, "was the situation at San Luis Rey, which down to the arrival of Echeandia eight years before, sheltered a happy and contented family of more than 2,000 Indian converts."

MISSION IS SOLD

Stirred to action by the misery of the Indians, Governor Alvarado on January 19, 1839, appointed William Hartnell, an Englishman, inspector of missions and directed him to prepare a report on conditions. Hartnell, credited with being sincere and honest, tried to help Mission San Luis Rey

Courtyard of Mission San Luis Rey de Francia. Photo by Byron Dome

On July 5, 1840, he removed Pio Pico as administrator and appointed Jose Antonio Estudillo of San Diego to succeed him. Pico, however, continued intrigues to gain possession of the Indian ranchos.

In March, 1843, Governor Manuel Micheltorena reinstated the Franciscans and on April 22d Mission San Luis Rey was turned over to Fr. Jose Maria Zalvidea. Peace came again to San Luis Rey, but lasted only two short years. Pico conspired successfully against Micheltorena, drove him from the country and himself became Governor. He was determined to wipe out the missions. He brought San Luis Rey to the verge of bankruptcy and on May 18, 1846, illegally sold the mission to Jose A. Cot and Jose A. Pico, including the Rancho Palo, for $2,000 in silver and $437.50 in grain. After American occupation this sale was nullified by the United States Supreme Court.

Under American Army control, San Luis Rey received kindly treatment. Pico fled to Mexico in August, 1846. Successive American Indian agents brought a measure of prosperity back to the mission and bettered conditions for the Indians. On March 18, 1851, President Abraham Lincoln returned the California missions to the church. Mission San Luis Rey possesses the original decree of return signed by Lincoln.

Neglected and abandoned except for various military occupations for half a century, pillaged by vandals, San Luis Rey by 1892 was in a sorry state of ruin. In that year, two Franciscan friars from Mexico asked and received permission from Bishop Francis Mora to establish a novitiate, erected a two-story frame building across from the church and on May 12, 1893, the mission was rededicated. Through the untiring efforts of Rev. Fr. Joseph O'Keefe, who devoted 19 years to his task, Mission San Luis Rey was restored to its present beautiful form. In 1913, the Sisters of the Precious Blood opened a school for girls there and today the educational institution near the mission represents an investment of $200,000.

Mission visitors leaving San Diego for San Luis Rey may follow the splendid State highway through the attractive communities of La Jolla, Del Mar, Cardiff, Solano Beach, Encinitas, La Costa and Carlsbad to Oceanside, "Gateway to San Diego County," and 38 miles from the City of San Diego. Or they may follow El Camino Real, main State highway, U. S. 101, over the new Rose Canyon route. Four miles up the San Luis Rey River from Oceanside is the famous Mission San Luis Rey. This old station of the padres is situated on an eminence which commands a splendid view of the surrounding country.

Motorists from the north will follow the State's unexcelled main highway, U. S. 101, from Los Angeles to Oceanside, passing en route the Mission San Juan Capistrano, third in the chain of missions stretching from south to north.

Mission San Juan Capistrano November 1, 1776

WHEN Father Junipero Serra founded Mission San Diego de Alcala it was his fond dream that a chain of Franciscan stations, each a day's travel apart, would be established extending from San Diego to San Francisco.

It was due to his ambition to fill in the gaps between the missions in San Diego, Los Angeles, San Luis Obispo, Monterey and San Francisco as rapidly as possible that the Mission San Juan Capistrano in Orange County was created in 1776. This mission is the third on El Camino Real, the ancient "King's Highway," but was the seventh of the 21 California missions founded by Father Serra and his brother friars.

Father Serra was in Monterey when, on August 10, 1775, he and Don Fernando Rivera, military commander, received from Viceroy Bucareli in Mexico authorization to launch two more missions. It was agreed that one station should be between San Diego and San Gabriel Archangel in Los Angeles near to a spot christened San Francisco Solano by Governor Gaspar de Portola in 1769. This name was not given to the new mission because the various patron saints had been chosen by the viceroy and San Juan Capistrano was next in line for honor. Hence the seventh mission was named after this saint.

INDIAN MASSACRE

Fathers Fermin de Lasuen of San Carlos de Monterey and Gregorio Amurrio of San Luis Obispo were appointed by Junipero to establish the new missionary center. Arriving at the site in advance of Father Amurrio, Lasuen erected an arbor, raised a large cross, blessed the ground and on October 30, 1775, offered up the first Holy Mass. Numerous Indians were present and welcomed the priest and his soldiers and set about helping to build a chapel.

On the same day that Father Amurrio arrived from San Gabriel with goods and cattle, word was received of the Indian massacre at San Diego de Alcala. Lieutenant Ortega immediately set out for San Diego with soldiers, leaving a small guard with the fathers and urging them to make haste and follow him. [illegible] the two missionaries [illegible]

Due to obstacles placed in their way by Rivera, Fathers Lasuen and Amurrio remained at San Diego for almost a year. And then Viceroy Bucareli ordered that the Mission San Juan Capistrano be established as soon as possible. Highly elated Father Serra himself at once set out for the abandoned site with a small party. Arriving there he found the cross still standing. He had the bells dug up, hung them in a tree and then rang them to announce to the Indians that the missionaries had returned. The natives appeared overjoyed, assisted in building an arbor and altar and on November 1, 1776, Father Serra offered up High Mass. This date is accepted as the day on which Mission San Juan Capistrano was founded.

On December 19th, seven weeks later, in a temporary chapel, Father Amurrio officiated at the baptizing of the first Indian child. The fathers proceeded rapidly with building construction, erecting a new chapel, concerning which Father Engelhardt, mission historian, says:

Exterior view of Mission San Juan Capistrano, showing garden and fountains

"In the absence of [illegible] we may [illegible] assert that Father Serra [illegible] 1777 and 1778 [illegible] still existing chapel [illegible] the present [illegible] therefore this chapel may [illegible] distinction of being the [illegible] church in California [illegible] founder [illegible] Holy Mass [illegible] Sacraments of Baptism and Confirmation."

On his farewell [illegible] October, 1783 [illegible] Father Serra [illegible] 221 [illegible]

[illegible]

Ruins of original Mission San Juan Capistrano destroyed by earthquake in 1812

Bridge Maintenance Practice On California Highway System

By HARVEY D. STOVER, Bridge Maintenance Engineer

THERE are [illegible] bridges on the California State Highway System, omitting culverts. Of this number 2,142 are built of steel and concrete, [illegible] of concrete or steel with timber approaches and [illegible] are steel bridges. The estimated value of these bridges [illegible] State [illegible] is $12[illegible].

The protection of this investment and the maintenance of the bridges in such condition that they will best serve the traveling public is a duty of the Bridge Department of the Division of Highways. Within the Bridge Department, maintenance work is handled directly by the Maintenance and Research Section. Methods of repair and maintenance as developed and tested by this section over a number of years have resulted in several practices that are worthy of note and should be of interest to the engineers and construction men engaged in this work throughout the Country.

There will be no attempt to take up all the maintenance problems encountered, but the more important features of the work [illegible] will be covered in a series of articles, the first of which will be devoted to Bridge Floor Maintenance. This subject was selected for the first article since it is the type of work that requires the greatest maintenance cost on the average bridge.

I

In general there are three types of floors [illegible] bridges:

1. Reinforced concrete.
2. Open steel [illegible]
3. [illegible] with [illegible] wearing [illegible]

vill not permit a heavy type floor ind on moveable bridges in those loca ions where provisions must be made 'or the passage of livestock, which atter condition is generally the rule hroughout the central valley and nountain regions of California Where light design, narrow width or oor alignment of the bridge wall re- quire structure replacement within a relatively few years, an untreated tim- ber floor is generally used

FLOORS ON STEEL BRIDGES

The reflooring of the Feather River Bridge at Oroville, State Route III-BUT-87-A, shown in illustrations Nos. 1 to 3, embraces unusual features worthy of note. The structure was built by Butte County in 1907 and had been posted for restricted loads since being incorporated into the State Highway System in 1933 Posting was required due to the light design of the floor beams and the stringers, although the truss members were adequate for legal loads.

The floor consisted of an asphaltic wearing surface on steel buckle plates riveted to the top flanges of the steel stringers. Longitudinal joints between the buckle plates were connected by rivets through a narrow steel splice plate. These splice plates were too thin to withstand the heavier wheel loads of modern traffic, and as a result rivet holes pulled out of round and the rivets worked loose, causing excessive deflections in the deck and breaking up the surfacing. This condition resulted in continual maintenance and in time would undoubtedly have resulted in complete floor failure.

A reinforced concrete floor was placed, utilizing the present buckle plates for forms. Since the truss system was adequate, it was desirable to increase the strength of the stringers and floor beams to provide for full legal loads.

3

ECONOMICAL DESIGN

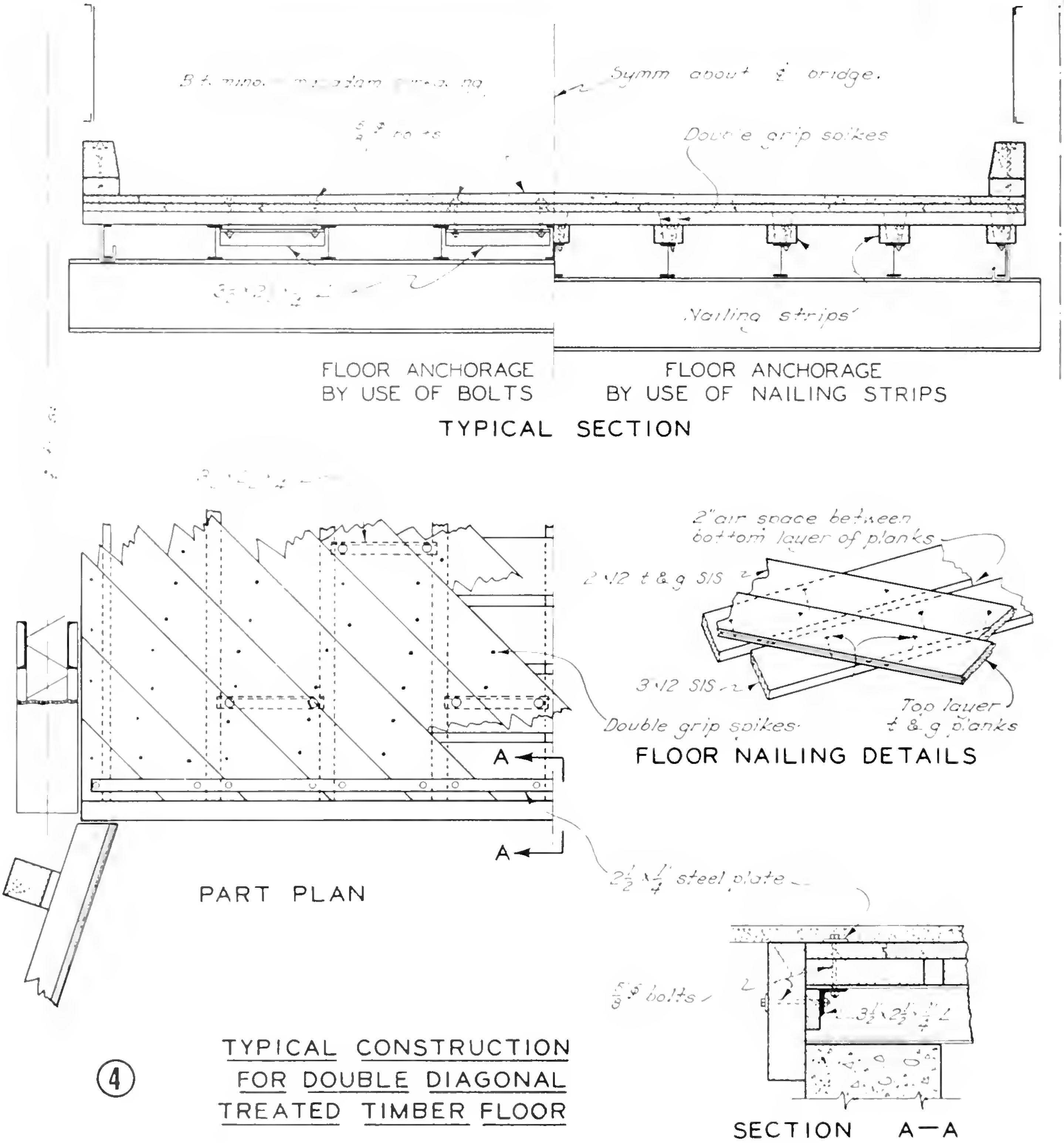
In order to correct the condition of the light stringer design, consideration was given to respacing the stringers and adding additional lines This method would have required the removal of the buckle plates and forming of the complete floor area for placing the concrete. A more economical design was accomplished by removing the rivets which secured the buckle plates to the top flanges of the stringers and replacing them with bolts and double nuts, permitting the head of the bolt to extend several inches up into the concrete slab. This method provided sufficient shear connections between the steel stringers and the concrete slab to allow the deck to function as a composite.

Reference is made to Illustration 4 which shows typical details for treated timber floors now being used on steel trusses. As noted in the illustration, the floor block is secured to the steel stringers with double grip spikes extending into nailing strips which are bolted to the top flange of the stringers. In many instances, the original design did not use nailing strips in which case the planks are bolted down by using short pieces of angles, which are cut to proper length and extend between the webs of the steel stringers, and thus anchor the floor to the top flange.

Other features in the design consist of spacing the bottom layer of plank sufficiently far apart to provide space for ventilation and the use of tongue and groove top layers, which to some extent prevent the surface from cracking at the joints, thus preventing moisture from entering the floor planks and stringers, all of which tend to prevent decay of the timbers. This type of floor has been used on a considerable number of bridges during the past few years and is giving satisfactory service

Although there is little to substantiate the statement that diagonal planking provides better distribution, it does have a very definite value in reducing impact, due to the fact that both wheels of an axle do not strike the same plank at once This type of

5



4

TYPICAL CONSTRUCTION FOR DOUBLE DIAGONAL TREATED TIMBER FLOOR

floor is often used on old steel bridges having timber stringers in which case the floor is nailed directly to the stringers, the latter being replaced as required at the time the floor is layed. A typical example is shown in **Illustration 5.**

The type of floors being used on timber bridges are either reinforced concrete slab or treated timber of the design above mentioned, providing the balance of the bridge is in good condition and on permanent alignment.

Due to the relatively large percentage of timber bridges in the State System, a large amount of floor maintenance and reconstruction work is required each year. During the past two year period 101 timber structures were refloored with reinforced concrete slabs cast on sheet metal forms which were nailed to the tops of the timber stringers. In addition, 32 structures were refloored with conventional

(Continued on page 17)

Improvement in Armor Coat Construction As Developed in Highway District I

By EARL WITHYCOMBE, Assistant Construction Engineer

IN the coastal areas of District I, air temperatures, because of fog and a prevailing westerly breeze rom the ocean, are consistently uniorm but never reach a very high legree throughout the construction eason.

This condition in conjunction with he specification requirement that no ituminous binder shall be spread vhen the atmospheric temperature is ess than 65° F, worked a considerable iardship on both the contractor and he State in the construction of armor oats on State Route 1 (Redwood Iighway) between Trinidad and ittle Red Hen in Humboldt County.

The contractor, being unable to lefinitely determine weather condiions in advance, arranged for his oiling crew to be on the job at the regular tarting time each morning with the iope that the weather would permit tarting operations without undue delay. Unfortunately, this was not isually the case and the crew would vait around for the sun to appear and he temperature to reach 65° F, which night be about noon.

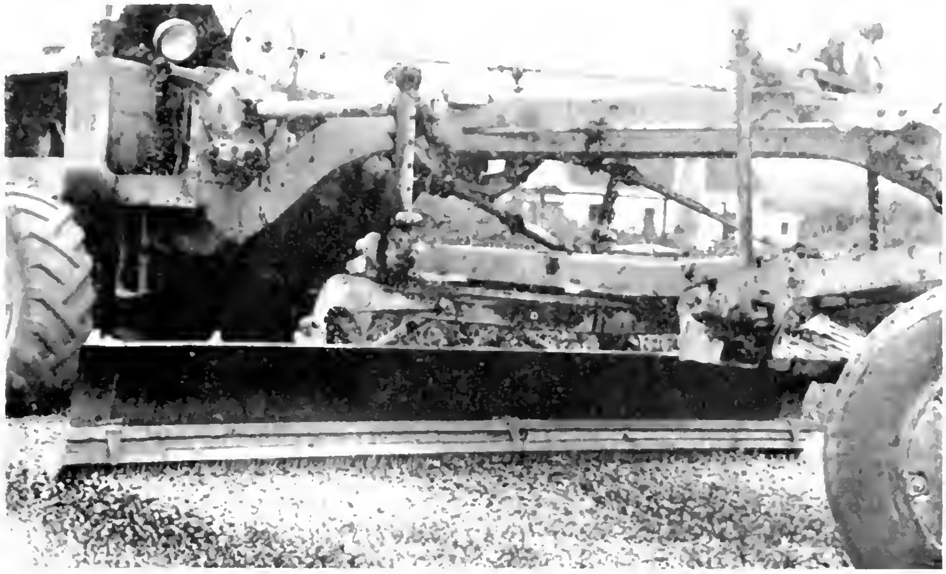
Consequently, the length of a working day was often but a few hours luration, with a resulting loss to the contractor, both in time and money, vhich ultimately would be reflected n higher prices to the State.

EXPERIMENT RECOMMENDED

The rigid requirement on air temperature is to insure that the hot sphalt penetrates the entire depth of creenings previously spread on the oad surface; otherwise, pitting and avelling soon develop in the finished avement.

At the suggestion of Headquarter's Construction Department, the District xperimented with splitting the spread of ¾-inch x ⅜-inch screenings into wo courses, with the thought that his would insure an adequate coverage of the screenings with asphalt, even though the air temperature was below the specified 65° F.

The rate of application was specified rom 60 to 70 pounds of coarse (¾-inch x ⅜-inch) screenings per square ard of surface. These were applied in the average amounts of 26 pounds and 36 pounds per square yard in the two courses. The first spread was given an application of 0.16 gallon of asphalt per square yard and the second, 0.20 gallon.



Steel broom on motor grader blade used for lighter spread of screenings

This was followed by an application of 20 to 22 pounds per square yard of medium (⅜-inch x No. 6) screenings, which were penetrated with 0.20 gallon of asphalt and covered with approximately 13 pounds of fine (¼-inch x No. 10) screenings.

PROBLEM SOLVED

The screenings used on this project were crushed from river gravel rejected over a 1½-inch screen and were

Steel drag broom being towed by motor grader

comparatively light in weight and less than the average specified weight was used. The coarse (¾-inch x ⅜-inch) screenings weighed 2,300 pounds per cubic yard, the medium (⅜-inch x No. 6) 2,100 pounds, and the fine (¼-inch x No. 10) 2,018 pounds.

After applying the tack coat of 0.12 gallon per square yard of surface, the initial spread of 26 pounds of coarse screenings was so light that each rock was in direct contact therewith, and except for spotting with additional screenings, no other work was usually required on this course.

The next application of asphalt at 0.16 gallon per square yard, effectively tied each rock to the tack coat and was immediately followed by the second spread of coarse screenings at 36 pounds per square yard.

Three to four men were then used to hand-spot, with additional screenings, any unevenly spread areas with considerable attention being directed to this detail to obtain uniformly distributed screenings.

BLADING WITH STEEL BROOM

The specified blading with pneumatic tired power graders was found to be impractical for these lighter spreads of screenings, and all blading was performed with a steel broom attached with hinges to the full length of the grader mouldboard. This grader with the attached broom and pulling a conventional drag broom, having two diagonal members and two that were transverse to the direction of traffic, leveled the spread screenings, making two trips, one in each direction. Upon completion of this leveling with steel brooms the screenings were rolled once. After rolling any depressions missed in the initial spotting were corrected by the spotting crew with additional screenings and hand brooming.

The theory of two trips with the brooming was to eliminate any tendency of the screenings to lay in one direction. It was also found that the smoothness of the final surface was largely dependent upon the care used in constructing the second course of ¾-inch x ⅜-inch screenings; the two important factors being the spotting and the two directions of brooming.

NEW SEQUENCE

The motor grader, equipped with the steel broom, was used only on the second course of ¾-inch x ⅜-inch screenings, as it was soon evident that for the medium and fine screenings, best results could be obtained with the drag equipped with steel brooms. To speed operations on these small screenings the drag broom was pulled by a pneumatic tired farm tractor at a speed slightly in excess of a fast walk. It was found essential to tow the drag broom with a relatively long tow rope and at a slow speed to keep the broom from forming ripples in the spread of screenings.

Two trips, one in each direction, were made with the drag broom over the medium screenings before rolling. The spotting crew followed the rolling and covered all spare spots or filled depressions. Upon completion of this operation the screenings were smoothed again with the drag broom in two trips, one in each direction, then re-rolled before spreading the final 0.20 gallon of asphalt.

The fine screenings were then spread, spotted, rolled, smoothed with the drag broom, then re-rolled, which is a different sequence for brooming and rolling as used on the other courses.

Traffic on this project was carried through construction under control which necessitated that where any course of screenings, except the first of 26 pounds of ¾-inch to ⅜-inch rock, was badly disturbed by traffic, it was rebroomed and re-rolled before applying the next spread of asphalt. Traffic, however, was slowed to a maximum speed of 10 M.P.H. when travel-

(Continued on page 22)

Rollers follow up the drag broom

Brooming medium screenings with steel drag pulled by light tractor

Hydraulic Structure Designed by Model Experiment by State Highway Engineers

By PAUL M. HINE, Assistant Highway Engineer

and

CHARLES E. DRESSER, Assistant Highway Engineer

PROPOSED plans for the relocation and widening of a portion of the Ridge Route in Los Angeles County require the construction of buttressed fills at several locations, in order to assure stability of the roadbed. The buttresses will be placed in existing canyons at the toe of fill, which will necessitate the construction of channel changes.

At one location, where two buttresses are adjacent to each other, three methods of providing a channel change were investigated and it was found to be most economical to construct the new channel over the buttress.

From the upper buttress to the lower one the difference in grades is 40 feet in a horizontal distance of 60 feet. A trapezoidal section of 10-foot bottom width with 1½:1 side slopes was selected for this steep grade as this would require a minimum length of transition to the channel section. The theoretical velocity at the foot of the channel chute, the point of impingement, is 47 feet per second for the maximum anticipated flow of 900 c.f.s. Grades approaching and leaving the chute are such that the uniform velocities are 7 feet per second for this quantity. The high velocity of the flow in the chute would result in erosion and turbulence for a considerable distance downstream.

Turbulence is undesirable from a functional viewpoint, and erosion increases the cost of maintenance, or in extreme cases may cause complete failure of the structure. Special structures, or dissipators, are used to reduce the velocity at the point of impingement to a rate of flow which the downstream grade will support without excessive turbulence.

Application of existing data on dissipator design, which is based on rectangular instead of the more economical trapezoidal sections, indicated that for a structure 10 feet wide, sidewalls 18 feet high would be required. The calculated depth of outlet flow for this design was in excess of the downstream design depth, and it was apparent that a wider structure should be used. Widening the dissipator would necessitate an increase in the chute width, and in long transition sections.

FOREWORD

A SHORT time ago Central Office instructed the districts that, insofar as district personnel would allow, someone with hydraulic experience should be designated to analyze all drainage problems and be made responsible for hydraulic design. For several years District VII had followed this policy, C. H. Parker being in charge of the hydraulic design. Also special effort has been made to have a number of men from other departments work for varying periods under Mr. Parker's direction in order that the district might become more hydraulic conscious.

Recently when a design for a rather unusual drainage structure was required, two of the men working under Mr. Parker became so interested in the problem that they arranged for the free use of the hydraulic laboratory of the University of Southern California and, working evenings on their own time, constructed a model. The accompanying article tells of their experiments.

The University has invited District VII to make further use of their hydraulic laboratory and when problems justifying it arise, the invitation will be accepted. However, in the future it is believed that we should allow the men regular highway time for such model experimental work.

By A. N. George, District Construction Engineer

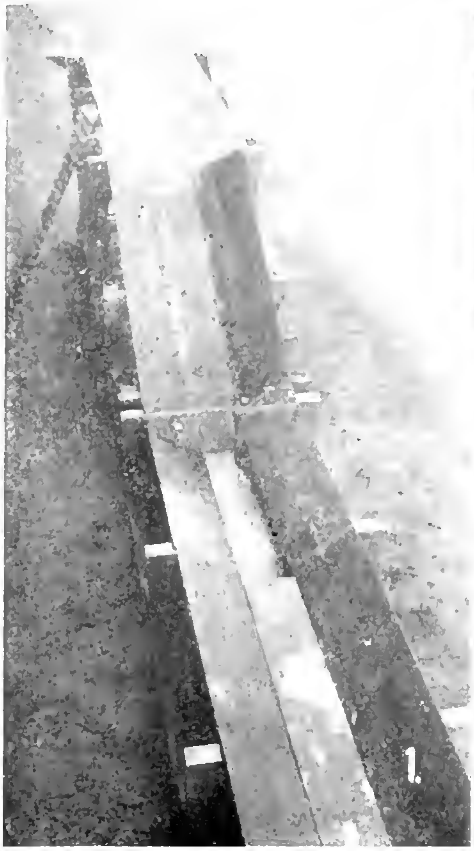
In order to reduce estimated costs it was decided to use a dissipating basin 10 feet wide with vertical walls only 5 feet high, and 1½:1 paved side slopes from the top of the basin to a height of 8 feet above (the design depth downstream), and rely upon an increased length to accomplish the desired velocity deceleration.

The correct length of basin could not be determined analytically so it was decided to solve the problem by model experiment. The model was constructed in such a manner that the length of basin could be varied, until the most satisfactory results were obtained.

In the experiment, it was found that a basin length of 60 feet was an absolute minimum; however, there was an undesirable rise in water surface at the end of the dissipator, with a resulting drawdown or drop in water surface which produced acceleration and further turbulence downstream. It was then decided to experiment with a stepped chute in order to retard velocities. The prototype dimensions of the step risers were 1 foot 6 inches and of the treads 2 feet 3 inches.

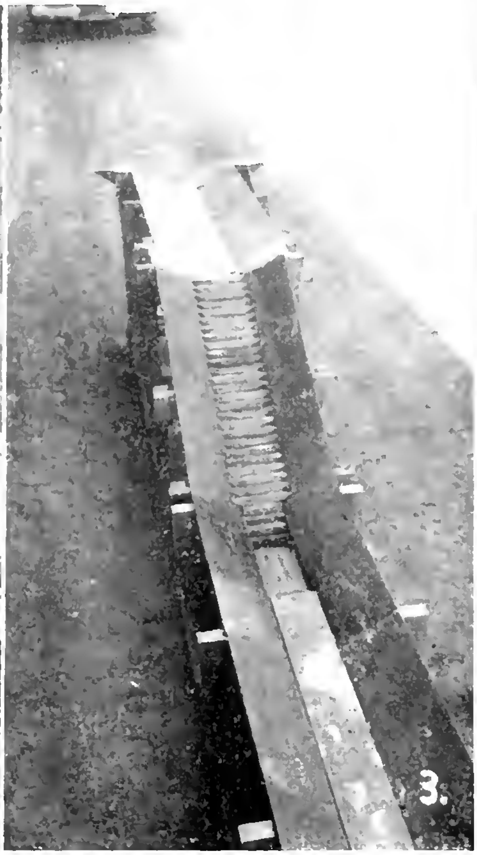
This approach gave more desirable results and a dissipating basin length of 40 feet was adequate to confine the water within the channel. Although the water surface behavior was improved, there still was too much turbulence near the end of the basin. All experiments so far had been conducted with a sill, or basin end-wall, of 5-foot height. This apparently caused an upward deflection in flow which was too abrupt, and it was decided to make the sill in two steps of 2 feet 6 inches each.

Alterations were made in the model, maintaining the adjustable feature of



Model as constructed for first trials. Dissipating basin in prototype is 5 feet deep and 60 feet long. See Fig. 2 for flow conditions

Same structure dimensions as Fig. 1. Flow is equivalent to 900 c. f. s. in prototype. Note extreme turbulence



Final revision of model on which design of prototype was based (see Fig. 5). Flow behavior is shown in Fig. 4

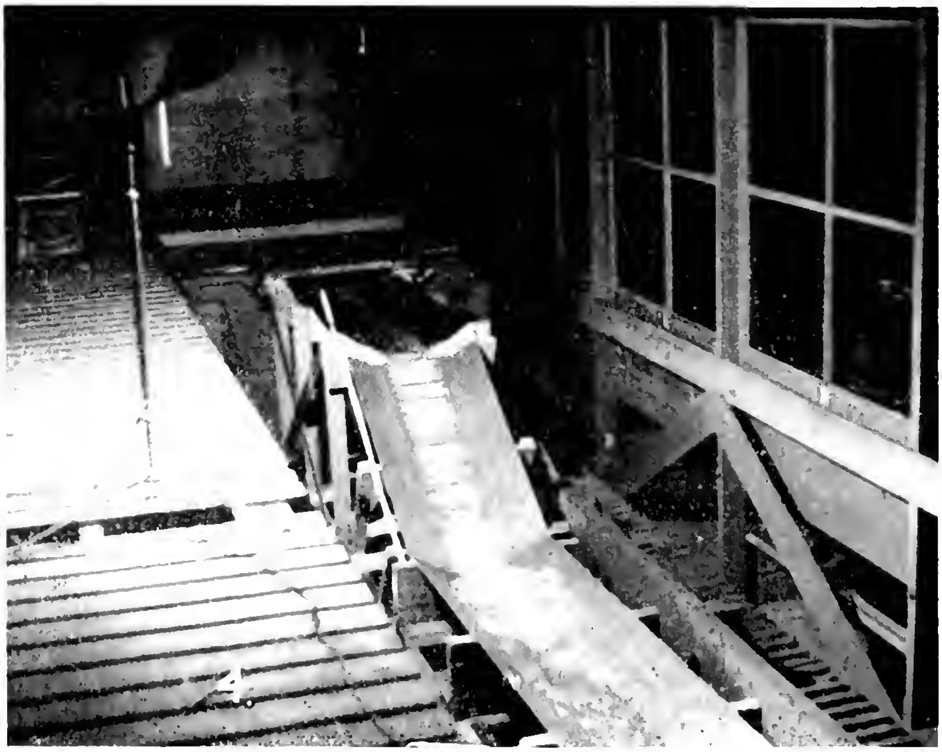
both sills so that they were free to slide with respect to the channel and with each other. Experiments were made with this arrangement, and it was found that the length of the lower half of the basin need be only 8 feet and the total length of the upper half only 28 feet, or an average length of only 18 feet.

Water surface behavior was further improved by a slight change in the sills. A triangular prism was placed on the face of the sills which served to partially deflect the flow from the center of the channel toward the sides. This equalized the depths of flow over the sill, whereas before the depth was greater at the center than at the sides.

It was now considered that the results obtained were satisfactory. Any further improvements would be of slight advantage at the sacrifice of economy.

After the design was fixed, by adjustment and revision of the model, [illegible]s equivalent to 2 foot [illegible] [illegible]ders in [prot]otype were fed into the channel to [st]udy their effect on the [illegible]. Due to the force at the foot of the [illegible] all

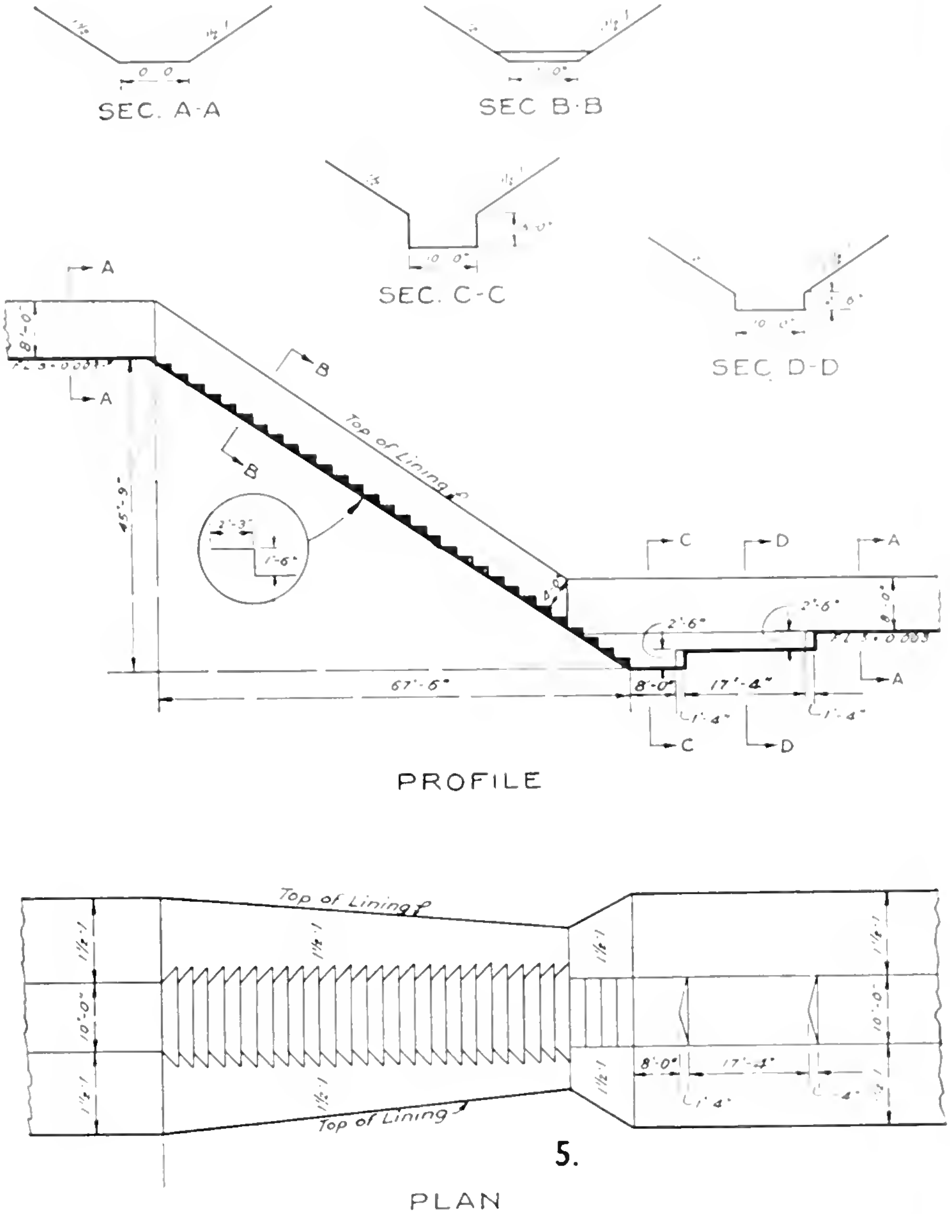
Same dissipating basin dimensions as Fig. 3. Flow is equivalent to 900 c. f. s. in prototype



rocks were carried over the first sill and deposited on the floor of the upper basin. The upper basin was filled to capacity with gravel, and additional rocks placed in the channel were washed out of the model, yet there was not, at any time, an indication that the prototype flow would be adversely affected by such bed loads. It may appear from these results that the upper basin was unnecessarily long; however, the experiments had fixed the adopted length as a minimum.

The advantages of hydraulic model study, for structures departing from conventional design, justify the small cost connected therewith. Such study indicates whether or not the design is adequate, thereby averting the possibility of failure, with resultant damage many times the first cost of the structure; on the other hand, it will suggest economies if the designer has been too conservative. In addition, the use of models is a very expedient means of design in that possible improvements can be made and their actual effect observed in much less time than required for a mathematical analysis which frequently is laborious or impossible. Wherever possible, such structures are used; however, due to the wide variation of local conditions, both topographical and hydrological, this is, in many cases, not feasible functionally or economically.

The experiments were conducted at the University of Southern California, and the writers are indebted to Dr. Robert E. Vivian, Dean of the College of Engineering; Prof. H. J. Miles of the Hydraulic Department; John C. Guillou, Graduate Laboratory Assistant, and Gerald Cimolino, Student Laboratory Assistant, whose cooperation made these experiments possible.



5.

Plan and Profile of Prototype based on model dimensions

Bridge Maintenance Practice on California Highway System

(Continued from page 12)

diagonal timber construction, the choice of type being governed by the condition or estimated remaining service life of the structure. This work was required in some instances due to the decay of the original timber floor, but in the majority of cases, replacement was necessary as a result of failure under the pounding of a large volume of heavy traffic. An average of 20 per cent of the stringers in the above noted work required replacement which had failed in diagonal shear or as a result of a poor grade of lumber at the time of installation.

REINFORCED CONCRETE BRIDGE FLOOR MAINTENANCE

A considerable number of the floors of concrete bridges in the highways system have required attention. Uneven riding surface resulting from plastic flow of the concrete is the most common cause, which is corrected by placing a leveling course of bituminous macadam surfacing.

In certain localities, concrete bridge floor failure has occurred as a result of frost action, spalling the surface resulting in unsatisfactory wearing surface and in some instances exposing the reinforcing steel. Maintenance in these instances, has been taken care of by use of bituminous macadam wearing surface, properly placed to provide a true riding surface.

Boy: Life was just one big desert until I met you.

Girl: Is that why you dance like a camel?

Development of Highway Traffic Data By California Division of Highways

By HARRY L. KILE, Assistant Traffic Engineer

These are types of motor vehicles tabulated in early day traffic counts

THE records of the California Division of Highways show that from its earliest beginnings there were those among its staff who did not wholly subscribe to the rather commonly accepted procedure of simply accepting the opinions of supposedly informed persons concerning highway needs.

It could, of course, be admitted that the roads throughout the State were for the most part inadequate to properly serve either the type of traffic or the volume of traffic which had been brought about by the development both of the State itself and of the motor vehicle. But, at least, to the few it was not enough to know only in this general way that there was unquestioned traffic need for highway improvement. They wanted to *measure* these needs; to know where this traffic was, what kind, and how much. So actual field traffic counts were made. The first regularly adopted form for these counts of which we have record was used in 1913. This form and the instructions which accompanied it are of real interest, even though somewhat amusing in the light of changes in the character of vehicles which have come during the past 30 years.

OLD TRAFFIC COUNT

Record was made of all vehicles passing a given location for a period of 14 hours each day for the full seven days of a week, the counts beginning at 7 a.m. and ending at 9 p.m., broken down into two-hour periods. Vehicles recorded were classified under the following groups:

Single Horse	Light Vehicle Heavy Vehicle
Two or More Horses	Light Vehicle Heavy Vehicle
Automobile	Runabout Touring Car Motor Trucks Motorcycles

"Light Vehicle" was defined as meaning "a buggy, democrat wagon, or any vehicle other than an automobile which is used usually for pleasure or light business purposes." "Heavy Vehicle" meant "a farm wagon, milk wagon, dump wagon, grocery or provision wagon or any vehicle except an automobile, which is used for carrying heavy loads." "Runabout" was defined as "an automobile built to carry but two people."

It is to be noted that the information sought concerned *rural* traffic, no provision being made for recording pedestrians or bicycles.

REGULAR PROGRAM ESTABLISHED

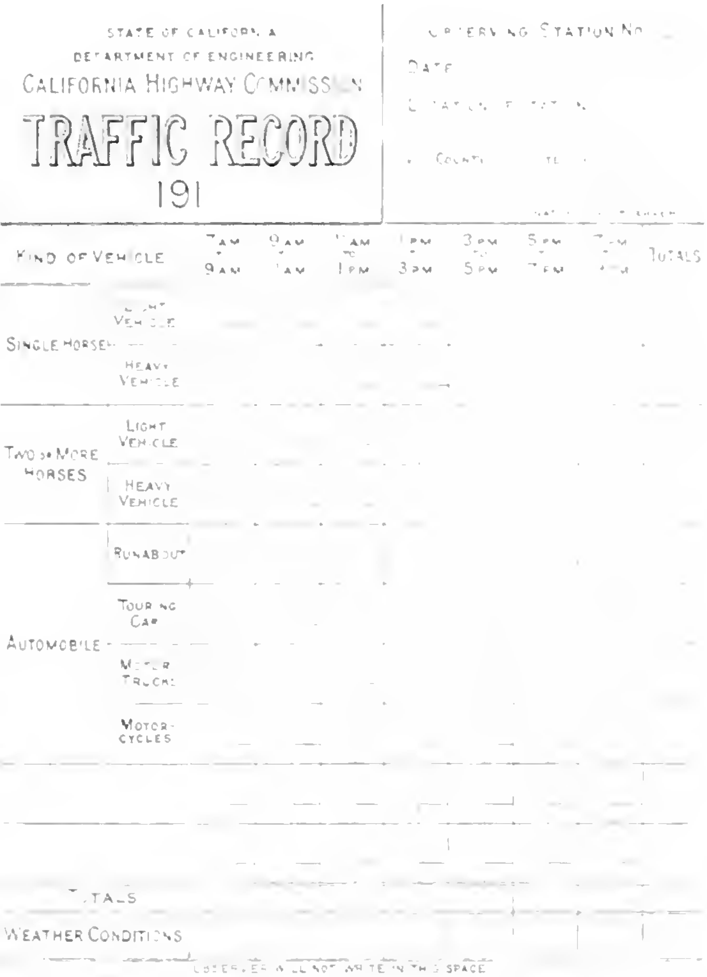
What direct use was made of the information derived from these actual counts is problematical. However, they *were* made; and as the State Highway System was gradually brought into being and construction of its various elements completed under the three principal bond issues, a more or less regular program for traffic enumeration on all routes of the system became established.

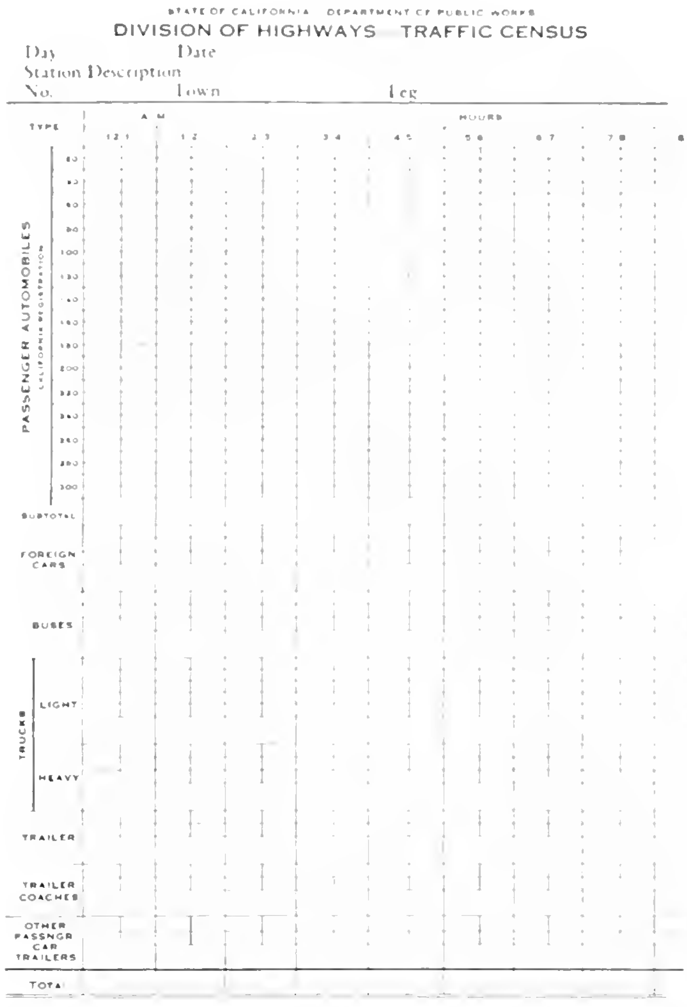
By 1924 counts were being made regularly at approximately 200 locations on the system, which then consisted of some 6,300 miles. For a time counts were taken during each of the four seasons, spring, summer, autumn, and winter, but by 1926 a program calling for semiannual counts had been settled upon and was continued without radical change until 1934. Counts were taken in mid-January and mid-July of each year during two successive days, Sunday and Monday, for the 16-hour period from 6 a.m. to 10 p.m., the traffic totals being shown for each hour. At the same time at a certain few representative stations widely spread throughout the system the counts were continued for a full seven-day period to determine daily variation. Certain counts also were taken for the full 24 hours of the day in order to develop necessary factors for expanding the regular 16-hour records.

COMPREHENSIVE SURVEY

In the latter part of 1933 the Division of Highways prepared plans for the organization and conduct of a comprehensive survey of highway transportation in California. Arrangements were made for the cooperation of the Civil Works Administration in furnishing the many thousands of field recorders needed for simultaneous recording of all road and street traffic throughout the entire State. The outcome of this was the "California Highway Transportation Survey, 1934," which has since served as the basis for all subsequent traffic studies carried on by the Division of Highways. This survey was truly state-wide in that actual field counts were made on all of the road systems, State, county, and city.

The mileage of the State Highway System had by this time increased to approximately 14,000 miles, of which about 12,500 miles were outside the limits of incorporated municipalities.


STATE OF CALIFORNIA
DEPARTMENT OF ENGINEERING
CALIFORNIA HIGHWAY COMMISSION
TRAFFIC RECORD
191
OBSERVING STATION No.
DATE
COUNTY
KIND OF VEHICLE | 7 AM - 9 AM | 9 AM - 11 AM | 11 AM - 1 PM | 1 PM - 3 PM | 3 PM - 5 PM | 5 PM - 7 PM | 7 PM - | TOTALS
SINGLE HORSE: LIGHT VEHICLE, HEAVY VEHICLE
TWO OR MORE HORSES: LIGHT VEHICLE, HEAVY VEHICLE
AUTOMOBILE: RUNABOUT, TOURING CAR, MOTOR TRUCKS, MOTORCYCLES
TOTALS
WEATHER CONDITIONS
OBSERVER WILL NOT WRITE IN THIS SPACE


STATE OF CALIFORNIA · DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS TRAFFIC CENSUS
Day Date
Station Description
No. Town Leg
TYPE | A.M. HOURS | 12-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8
PASSENGER AUTOMOBILES (CALIFORNIA REGISTRATION)
SUBTOTAL
FOREIGN CARS
BUSES
TRUCKS: LIGHT, HEAVY
TRAILER
TRAILER COACHES
OTHER PASSNGR CAR TRAILERS
TOTAL
(SEE INSTRUCTIONS ON OTHER SIDE)

In the days when horse drawn vehicles predominated, the traffic record form shown on the left was used by the California Highway Commission. The form on the right is used by the Division of Highways today

During this survey approximately ,000 traffic count stations were established on the rural portion of the ystem. The very large majority of hese were at intersections, with traffic eing recorded on each of the various egs and the stations themselves so ocated as to provide the basis for an ccurate traffic profile.

LITTLE CHANGE IN MILEAGE

There has been but little change in he total mileage of the State Highvay System since that time and the raffic stations then established have, vith the exception of a minor number f necessary modifications, been reguarly occupied during all the intervenng years. In this way it has been ossible to develop and maintain exact omparisons with the comprehensive ata established by the basic 1934 'ransportation Survey.

The practice of recording traffic nly semiannually in mid-January and mid-July provided no adequate guide as to seasonal trends. The January counts for the most part simply indicated the minimum traffic movement and the minimum is of little interest in traffic matters. July traffic on the other hand quite generally approximates the peak movement. With this in mind it was decided to retain the mid-July annual count at all of the 1,000± regularly established stations but to discontinue the similar count in January. And in order to obtain desired information as to seasonal trends and thus be able to accurately estimate the yearly traffic volume from the state-wide base of the July census, "monthly count stations" were established in 1936.

Certain selected ones of the regularly established annual count stations were also occupied for a full 24-hour period on the mid-Monday of each month throughout the year. These served to indicate seasonal variation and to provide those data necessary in developing expansion factors which when applied to the overall July annual count would make possible a close approximation of traffic for the entire year. Some 40 locations widely scattered throughout the State Highway System were picked as being generally representative for the indication of seasonal traffic variation in their several surrounding areas. The final estimates of traffic arrived at by means of these various actual field counts have been found to consistently check within remarkably close limits independently-arrived-at estimates based upon net gasoline consumption.

SEASONAL VARIATION

The original monthly stations were chosen with the idea in mind of determining seasonal variation for the State Highway System as a whole, and as noted the selections then made proved in actual use to be truly representative for this purpose. Increasing interest and resulting demand for factual traffic information to be used as a determining guide in various activities of the several highway districts pointed to the desirability of supplementing the group of monthly stations to make possible not only the determination of seasonal variation for the State as a whole but also to provide corresponding seasonal factors for each of the eleven districts separately.

Accordingly the number of monthly stations was approximately doubled in 1939 and these have since been maintained so that at the present time some 80 locations are regularly counted on the third Monday of each month throughout the year.

As previously noted, all monthly counts covered the full 24 hour period. However, at the close of 1940, after a careful study of the hourly variations developed during the previous years, it was decided that these monthly counts could safely be reduced to the normal 16-hour period 6 a.m. to 10 p.m. which corresponds with the regular annual July count. By use of factors developed in the study, this 16-hour count could be accurately expanded to produce the full 24-hour traffic. Monthly counts since that time have been for 16 hours only.

7-DAY COUNT

In order that a strict control may be kept on the various expansion factors needed to produce a yearly traffic total, a full 7-day count is made at each of the regular monthly stations at the time of taking the annual July count. And during four of these seven days, namely Friday, Saturday, Sunday and Monday, the counts also cover the full 24 hours of the day. In this way we have been enabled to reaffirm or to modify previously determined factors for hourly and daily variation as well as the seasonal variation which is revealed by the monthly records.

In the organizational setup of the California Division of Highways the Districts—of which there are 11—are to a large degree independent units. For this reason it is quite desirable that there should be definite knowledge of the extent and character of traffic with which each of them has to deal. Recognition of this prompted the establishment of the additional monthly traffic stations in 1939. Each district in itself is sufficiently large to include areas of divergent seasonal trends and the supplementary stations were located with a view to adequate coverage of these varied conditions. With the establishment of these monthly stations, arbitrary boundaries were determined upon for each district, delimiting the areas of influence for the individual stations, thus creating "traffic subdistricts" within the several Highway Districts. In this way, by having quickly available factual information of the main elements of traffic content and volume characteristic of and applicable to any or all of the individual road sections within these comparatively small subdistricts, it is possible to reach prompt decisions with respect to a large majority of contemplated highway projects in so far as the traffic elements of the project may be decisive in the conclusions to be reached, without the necessity of conducting special traffic surveys in each individual case.

VALUE OF COUNT

While the knowledge of traffic provided by this continuous and regular program of field recording is basically invaluable for the proper direction of the activities of the highway organization there is, of course, the need in many instances for special knowledge of further details which may be of peculiar and deciding influence in the review of individual projects. This is especially true of intersections if anything other than the most minor or elementary treatment is involved.

Subject to such modifications as may be apparently desirable due to conditions unique to the location being studied, the normal intersection survey records traffic by both type and direction in 15-minute-interval totals, special forms being used for these counts.

Another of the elements of traffic besides those of volume, vehicle type, and direction of movement is the very important one of speed. In recognition of this, state-wide speed surveys are conducted to establish practices and trends of traffic in general, and special speed studies are also made in connection with single projects or abnormal situations. During the present war emergency period overall speed checks to determine general trends have been made at some 70 or 80 locations throughout the system. The locations chosen were at points on the highway where no legal restriction on speed existed and where physical conditions were such that the traffic speeds noted would reflect normal driving habits. Speed studies had been conducted at all of these stations during previous years so that direct comparison with past practice was possible and can continue to be made in the future as need arises or more current knowledge is deemed desirable.

STANDARD FORMS

The standard forms employed by field recorders in taking the regular traffic census provide for the following breakdown of vehicle types:

California Passenger Cars
Out of State Passenger Cars
Busses
Trucks—Light
Trucks—Heavy
Truck Trailers
Trailer Coaches
Other Passenger Car Trailers

(Continued on page 23)

State highway crew starting for work in 1913

CALIFORNIA MISSIONS

ctober 18, 1806. Meanwhile numerous adobe houses had been built for the Indians and their families. Old records show that in 1809 the fathers had constructed an aqueduct to bring water to the mission. By 1812 the mission was prospering wonderfully and then an evil fate undid the labor of years.

On the morning of December 8, 1812, while early Mass was being held, a terrific earthquake hit San Juan Capistrano, leveling the beautiful new church that had been nine years in the making and killing 40 Indian worshippers. There were only six survivors.

MISSION SACKED BY PIRATES

Except for removal of debris and necessary repairs, the heartbroken mission fathers undertook no rebuilding until 1814. In 1818 they suffered another tragedy when two Argentine privateers seized Monterey, demanded that the Californians renounce Spain and join the Argentine revolutionists, looted the place and then landed at San Juan Capistrano, where they sacked the mission and burned some buildings.

As early as June, 1821, friction developed between the military and civil authorities and the fathers of San Juan Capistrano. Repeated demands for cash and the products of the mission fields were made by the civil government and the priests came to feel, and quite justly, it would seem, that they and their Indian charges were being imposed upon.

Their troubles increased with the coming of Jose M. Echeandia, the first native Mexican to become Governor of California. One of Echeandia's first acts was to order Fathers Barona and Zalvidea of San Juan Capistrano to swear allegiance to the new Constitution of the Federal States of Mexico. This the priests, both of whom had taken the oath of the Independence of Mexico from Spain, refused to do, as did nearly all the Franciscan missionaries.

ENEMY OF PADRES ACTS

An avowed enemy of the priests, Echeandia set to work to destroy San Juan Capistrano mission. On July 25, 1826, he issued a proclamation emancipating the mission Indians of California. This action proved disastrous to the San Juan Capistrano natives. They became shiftless and disorderly. The Governor and his political associates had their eyes on the mission lands and cared not what became of the mission converts.

Political upheavals, which resulted in the ousting of Echeandia and his return to power after a successful revolt against Governor Victoria, added to the woes of the mission fathers. In 1833, Governor Figueroa emancipated all the Indians at San Juan Capistrano. He followed this by confiscating mission lands, part of which was divided among the neophytes and the remainder granted to friends. A [illegible] in charge of the mission. Aged Father Zalvidea, ill and grief stricken, remained to be near his converts.

Upper—View of interior of chapel at Mission San Juan Capistrano. Lower—Courtyard of this mission, showing old mission bells.

Highway District IV Felt Impact of War

(Continued from page 4)

to widen the main highway between Vallejo and Napa to four lanes. Due to many calls on District IV personnel the planning and supervision of the District IV portion of this highway in Napa County was taken over by District X. This construction was fully described in the last issue of this magazine.

In addition to the pure access roads the District's activities on the State Highway System have been carried on as an integral part of the war effort. Many miles of the strategic network are included in the Bay counties and these, too, are in the same light as access roads as regards service to the armed forces and war industries.

Fourteen major projects have been undertaken and completed since December 7, 1941 and have involved construction on approximately 46 miles of State highways at a cost of approximately $3,850,000. These projects consisted of new construction along the coast road in San Mateo County (Tunitas to Lobitos) and between Watsonville and Rob Roy Junction in Santa Cruz County. The balance were in the nature of widening or reconstruction of existing highways to high standards.

To forestall complete destruction of existing pavements a total of 31 blanket jobs or minor improvements have been completed since the war put a stop to the major reconstruction program. These 31 projects have repaired approximately 91 miles on all types and classes of State highways and have called for the expenditure of about $1,600,000.

The access road program is now nearing completion and the District's planning is being concentrated on postwar projects. Of the program approved by the California Highway Commission for primary consideration for construction in the postwar era, nine of the original fourteen projects have been prepared and the balance are in process of design.

The District's construction program has been seriously handicapped by loss of 35 of the engineering personnel to the armed service, a loss of approximately 25 per cent of the normal staff. This loss has lately been offset to a considerable degree by the transfer of men from other districts.

Unit of Former State Employee Cited for Valor

WHEN H. L. Grayson, who was a member of the maintenance crew of the State-owned Carquinez Bridge, took a military leave from the Division of Highways to enlist in the Fortieth Construction Battalion of the Seabees he really joined a fighting outfit. Among the souvenirs he will have after the war will be a copy of a presidential citation for his unit awarded for outstanding performance in the Admiralty Islands, which reads as follows:

"The Fortieth Construction Battalion, United States Navy, is cited for outstanding performance of duty in action against the enemy on Los Negros Island, Admiralty group, on March 2, 1944. This unit landed during a critical situation when the holding on the harbor and airstrip against overwhelming enemy forces was precarious.

"Notwithstanding the fact that the area was still under enemy fire, the battalion immediately on landing assumed its assigned work in clearing and repairing the airstrip. During the progress of their work it became commonplace for the operators to be fired upon by snipers, and for the operators to return the fire while continuing their work.

"It soon became evident that cavalry patrols operating against the enemy required fire lanes into the jungle to permit concentration of automatic weapons against the enemy and the Fortieth Construction Battalion had no sooner learned of this need than they turned their bulldozers into the jungle, cut the required fire lanes in superb disregard of the enemy fire and established adequate areas for the control of the enemy.

"During the hours of darkness the members of the battalion were continuously harassed by infiltrating enemy patrols, and for their own preservation operated effectively as combat troops.

"After working all day and fighting all night, small parties of the construction battalion personnel still found time during their few hours of leisure off duty to rout out small bands of the enemy, locate and report pillboxes and otherwise carry the offensive to the enemy's positions.

"The cheerful and uncomplaining attitude of these engineers and the outstanding spirit was noticeable to all associated with the unit and gave great encouragement to the troops in contact.

"In particular, the operation of the bulldozers into the teeth of the enemy's positions was most inspiring and heartening, and created an immediate resurgence of the offensive spirit in weary troops."

Improvement in Armor Coating is Developed

(Continued from page 14)

ing over the spread screenings, which did much toward keeping the rock in place.

SUCCESSFUL RESULTS

All center laps were staggered from side to side for each course by using 9.5 and 11 foot spreads, which will prevent extensive bleeding at this point in the future.

All rolling was accomplished with two 8-ton tandem rollers. Screenings were spread on the road with a Buckeye spreader and after the crew became familiar with this spreader, very good results were obtained in the minimum of time.

Successful results were obtained with this method of armor coat construction with air temperatures as low as 50° F. This was the objective sought. Much to the surprise of everyone, the riding qualities were improved to a remarkable degree. Armor coat that averaged 48 inches of roughness per mile in 1943, as measured by the roughometer, were constructed as smooth as 15 inches per mile. This compared very favorably with the best riding pavements of any type.

The contractor, using a green crew, made an average daily production of 1754 lineal feet of completed armor coat 20 feet in width, and had a high production of 3400 lineal feet one day before the work was completed.

Under similar weather conditions it was his opinion that the methods used on this project were conducive to increased production and decreased costs over the conventional specified methods and in areas where the temperatures were high, they might show the same desirable results.

On the construction of this project, Contractor Marshall S. Hanrahan was represented by Superintendent Sam Ball, and the State by A. M. Nash, District Engineer; C. P. Sweet, District Construction Engineer, and in immediate charge of construction, H. M. Hansen, Resident Engineer, with Lester Spinney as street-man.

Mrs. Jones was spending a day in bed with a severe cough and her husband was working in the back yard, and hammering nails into some boards. Presently, his neighbor came over.

"How's the wife?" he asked.

"Not very well," replied Jones.

"Is that her coughin'?"

"No, you fathead, it's a henhouse."

Traffic Data Development

(Continued from page 20)

In the making of speed checks vehicles are separated into the following categories:

- Passenger Cars
- Busses
- Light Trucks
- Heavy Trucks
- Trucks with Trailers

While the several classes of surveys so far enumerated provide the main features essential to the intelligent review of the traffic situation, there are numerous other elements which have direct and important bearing in specific cases and so call for separate investigation. Among studies of this kind are "time and delay," "approach speeds," and "traffic behavior" studies of many types.

In reciting this outline of the manner in which we go about the work of acquainting ourselves with needed information on the traffic we must serve, there has been no intention to present any of the methods as being uncommon or exceptional in themselves. In one important respect, however, we do perhaps occupy a position of more than ordinary advantage. That is the possession of broad and quite comprehensive background of factual traffic data sufficiently complete as to detail and marshalled in such manner that it is *usable*.

Traffic data can not be manufactured or produced at will in some artificial way in a laboratory. It must be accumulated *over the years* and *throughout the system*. And if in the field-gathering the records kept have been so simplified as to constitute little more than the total sum of vehicles observed, such records quickly reveal their inadequacy the moment any attempt is made to put them to real use. Without certain essential detail, totals may indeed be worse than useless in that they lend themselves to decisions based on mere speculation. A similar lack of substantial value can be ascribed to information which must be based on data acquired during a single count or isolated survey, which in themselves may be sufficiently complete as to detail but which, since they must stand alone, in reality represent only conditions as of the date the observations were made.

The California Division of Highways is unusually fortunate in this regard by reason of many years of continuous records of traffic covering the entire system and sufficiently detailed for nearly all essential needs. Directly tied in as they are with the State-wide comprehensive Transportation Survey of 1931, and carefully supplemented by many special studies, these records provide reliable support for judgment in the wide variety of highway problems which must be decided daily.

Pioneer State highway crew prepares to load its wagon for field work

CALIFORNIA MISSIONS

(Continued from page 21)

Through successive governmental regimes, San Juan Capistrano continued its decline and in June, 1841, the Indian community was dissolved and most of their lands divided among settlers. The mission became a pueblo by official decrees. Father Zalvidea departed for San Luis Rey about the end of 1842 and for four years there was no resident priest at San Juan Capistrano.

The mission came to an end on December 4, 1845, when it was sold at public auction by Governor Pio Pico to John Forster, his brother-in-law, and James McKinley. On July 7, 1846, the American Flag was raised at Monterey, 13 years too late to serve San Juan Capistrano and the other missions. San Juan Capistrano was returned to the Catholic church by President Lincoln on March 18, 1865.

Over a period of 60 years, Mission San Juan Capistrano, known as the "Jewel of the Missions," crumbled into ruins. Its restoration to its present day beauty was started in 1895 by Charles F. Lummis and the Landmarks Club, which he founded, and was completed by Father St. John O'Sullivan, beloved pastor of the mission.

Mission San Juan Capistrano is in Orange County almost midway between San Diego and Los Angeles. It is approximately 70 miles from San Diego on El Camino Real, the main State highway. Mission visitors traveling north from Mission San Luis Rey, second in the chain of Franciscan stations stretching from San Diego to Sonoma, leave the charming City of Oceanside and proceed 29 miles to San Juan Capistrano passing through Serra, named in honor of Father Junipero.

This mission is 23 miles south of Santa Ana, county seat of Orange. Leaving this city, the mission motorist en route to San Juan Capistrano passes through Tustin and Irvine, centers of an amazingly beautiful and wealthy citrus district. At the mission, flowers bloom the year 'round in the garden surrounding the cloisters and the bells of the campanario daily peal forth the Angelus and call the faithful to Holy Mass.

Next—Mission San Gabriel Arcangel and Mission San Fernando Rey de Espana.

LANDSCAPING of California State highways to control bank erosion and to obliterate unsightly earth scars caused by construction is receiving more and more attention from the Division of Highways.

These two photographs show examples of landscaping on Cahuenga Pass Highway. The views are looking northerly, showing the Pilgrimage Bridge, at the south end of Cahuenga Pass Highway, main entrance to the Los Angeles metropolitan area from northern coastal points. The upper picture was taken before and the lower picture after landscaping, which was supervised by the Division of Highways in cooperation with the City of Los Angeles. All plant material was obtained from Los Angeles city parks and municipal nurseries. The lawn in the foreground of the lower photograph was planted with kikuyu grass. The main advantage of this grass is its ability to crowd out Bermuda grass and remain green during the winter months. Unlike Bermuda, it bears no seed and therefore may be confined to any given area. The palm trees were salvaged from another highway project, which was under construction through Elysian Park in Los Angeles.

THESE photographs show another example of landscaping. The views are looking easterly at the Marmion Way bridge over the Arroyo Seco Parkway between Los Angeles and Pasadena.

Due to a very limited right-of-way, the fence and objectionable views from the highway shown in the upper photo- raph were screened off by the use of native shrubs and various types of vines. The lower picture, taken after planting, lustrates the use of shrubbery to shield headlight glare on a curve.

San Francisco-Oakland Bay Bridge Completes Eight Years of Operation

By HOWARD C. WOOD, Senior Bridge Engineer

THE first eight years of operation of the San Francisco-Oakland Bay Bridge were completed on November 12, 1944, with a record which is outstanding in many respects and is especially noteworthy when viewed in the light of the contribution of this great transportation artery to the prosecution of the war.

Since the date of its opening the bridge has carried 120,156,686 vehicles and collected its share of tolls from 110,655,000 interurban train passengers.

As of November 12, 1944, total revenues approximated $44,800,000.

VEHICULAR TRAFFIC

Beginning with a modest figure of about 25,000 vehicles per day, the use of the bridge increased steadily during the next three years, with a particularly accelerated rise in traffic during 1940.

By the latter part of 1940, the initial effects of America's defense preparations were beginning to be felt. The rapid pace of these preparations continued to increase, especially in industrial centers like the San Francisco Bay Region, and highway traffic generally reflected this expansion.

Bay Bridge traffic reached a peak during the autumn of 1942 when for several months the daily average number of vehicular crossings exceeded 60,000. With the extension of gasoline rationing to the Pacific Coast in December, 1942, bridge traffic suffered a sharp drop. In December, 1942, and January, 1943, the daily averages were 43,637 and 45,871 vehicles, respectively. However, traffic volume on the bridge has gradually risen since that time, reaching an average of about 53,000 vehicles per day during recent months.

In the war years the increase in heavy trucking and in bus passenger traffic has been very pronounced, reflecting the expansion of war production activities as well as the curtailment in the use of private passenger automobiles.

In spite of the continued large volume of traffic, the Bay Bridge accident record has remained low.

INTERURBAN TRAIN TRAFFIC

On January 15, 1939, interurban train service across the bridge was inaugurated. During the first two years of operation, these trains carried an average of between 50,000 and 56,000 passengers per day. As a result of the abandonment of service over certain lines, a low point was reached during the latter part of 1941 with an average of about 32,000 passengers per day. However, with the increase in the tempo of the war industries and the effects of the gasoline and tire shortage, the travel on the interurban trains increased at a high rate during 1942, reaching an average of more than 58,000 passengers per day at the end of the year. For the year 1943, the average was almost 59,000. During 1944 there has been another pronounced rise, reaching an average of almost 70,000 passengers per day in September.

FINANCING

The bridge was originally financed by the sale of revenue bonds in the total amount of $73,000,000 to the Reconstruction Finance Corporation. In addition, an allotment of $6,600,000 was granted from the State Highway Fund to be used for the construction of the bridge approaches, subject to the requirement that after the redemption of all revenue bonds, this amount would be refunded to the Highway Fund out of toll collections. In 1939 a refinancing was effected and a new issue of 4 per cent bonds in principal amount of $71,000,000 was sold to a syndicate of investment houses. The specified redemption date of the last of these bonds was 1976.

The large volume of bridge traffic and the consequent increase in income, coupled with changed conditions in the securities market, made it advisable in the early part of this year to consider another refinancing of the debt. After careful consideration of all factors, this was accomplished by action of the California Toll Bridge Authority through the sale on May 22, 1944, of $56,000,000 principal amount of revenue bonds at an average interest rate to maturity of 1.96613 per cent, effecting a saving of $5,097,000 in interest costs (California Highways and Public Works, May-June, 1944).

Under the new bond issue, the last redemption date is September 1, 1962. However, should revenues continue at the 1942-1943-1944 level (approximately $6,000,000 annually) all outstanding bonds will have been retired by 1955.

In addition to making it possible to advance the date on which the bridge bonds will be redeemed, the large traffic volume has also resulted in a series of reductions of automobile tolls from the initial rate of 65 cents per car to the present 25 cents per car, with corresponding reductions in most other vehicle classifications.

BRIDGE MAINTENANCE AND OPERATION

The problems of maintenance and operation have been greatly aggravated by the acute manpower shortage.

In the toll collection department the serious situation has been relieved in part by the employment of women as collectors. However, there is still a large turnover and on many occasions a shortage of qualified personnel exists.

The painting and other maintenance forces have been unavoidably reduced; however, it has been possible to maintain the minimum crew necessary to prevent the occurrence of permanent damage to the structure through excessive paint deterioration or other causes.

The emergency service crew, which handles the operation of the fire engine and the tow trucks, is likewise short-handed. However, by careful assignment and by "streamlining" some of its operations, this crew has been able to maintain a high efficiency in its work of keeping the bridge decks clear of stalled vehicles.

(Continued on page 28)

Origin of Sections, Townships and Ranges Goes Back to Colonial Days

(Continued from page 5)

lted in confusion and litigation. ut it was only natural that such a stem as the one last described, ould exist in the South, where there ere large plantations, slave labor, d a mild climate favoring the extension and scattering of settlements over e coast lands, while in the inland untry, the system enabled the oneers to locate good lands along e streams, rivers and lakes. Some irginia statesmen, notably Thomas efferson, had urged that the New ngland System be adopted in the sposal of the Virginia State lands, it without success.

Thus, we see that, prior to the evolution, no uniform system of land rangement had been worked out. he union of the 13 colonies was very eak, and precluded any grant of ower over lands to a central legislare. Then, too, before the Revolution, the idea of National lands outside e State, had not yet developed.

REVOLUTION

Then came the Revolution, with its onsequent victory for the colonies. he first result of the victory was for e patriots to claim as much territory s possible for the new Government. ix of the colonies had sea-to-sea aims, based on ancient charters. hese were Massachusetts, Connecticut, Virginia, North Carolina, South arolina, and Georgia. But the other tates had no charter claims to the nds west of the Alleghenies, and ere restricted to definite boundaries.

Inevitably, a controversy arose. id the lands beyond the Alleghenies elong to the States under their chars, or to the United States, as a result f the successful Revolution? The tates with definite boundaries, eaded by Maryland, argued that hile the western lands should as gainst England be considered as a art of the States, the Continental ongress should limit the boundaries f the great States, and erect new olonies. The upshot of this state of ffairs was, that the smaller States efused to ratify the Articles of Confederation until these disputed lands vere ceded to the Nation for the common good.

New York and Virginia agreed to ede their lands in 1780 and 1781, hereupon Maryland ratified the Articles of Confederation. Between 1782 and 1807, the seven claimant States ceded their lands, creating a public domain for the benefit of the central Government. These lands covered all the territory between the Alleghenies and the Mississippi, with the exception of Kentucky, which was reserved by Virginia, and the Connecticut Reserve in Ohio. All lands thus ceded, not covered by the above reservations, or reserved as bounties by Congress to the Continental Army, were to be considered as a "common fund for the use and benefit of such of the United States as have become, or shall become members of the Confederation—and shall be faithfully and bona fide disposed of for that purpose, and for no other use or purpose whatsoever."

CONGRESS ASSUMES POWER

The Articles of Confederation conferred no power on Congress to accept or govern any common lands, but Congress assumed that power. Here we have a vast public domain under the control and disposition of the Continental Congress, making possible a plan for a National system of plotting public lands. The natural outcome of this situation was a lively discussion, as to the policy of controlling and disposing of this land. At those times these lands were considered primarily to be used as a producer of revenue, and the actual value of the land was greatly exaggerated. The public and Congress looked upon these western lands as valuable assets that should be carefully managed.

EARLY PLANS

Early in 1781, one Pelatiah Webster, proposed a system for the sale of these public lands which was highly suggestive. He proposed that the land should be surveyed into townships of six, eight, or ten miles square. Webster also provided that the land should be sold at public auction in whole townships to the highest bidder; the minimum price was to be one Spanish dollar per acre; purchasers should be obliged to settle and improve the land within two or three years, or forfeit the same; and lastly, the townships should be laid in courses or tiers, and only when one tier was settled should the next one be placed on sale. He also provided that salt licks, coal and mineral lands should be reserved for the public use.

Webster's plan had several merits. It tended to push out settlements in close columns, easily defended from the enemy; laws and customs could be easily extended; and the absentee proprietor could not profit by the hardship and labor of the pioneer.

Between 1781 and 1784, when the first Congressional land committee reported, the western lands were several times before the attention of Congress. When Connecticut offered to cede her lands in 1780, she insisted that the township system be extended over the land ceded by that State. This system of disposition was accepted by the committee which reported on the cessions of New York, Virginia, and Connecticut. No action was taken on this report by Congress.

THE "ARMY PLAN"

Early in 1783, 283 Army officers proposed to establish a new State northwest of the Ohio. They petitioned Congress for satisfaction in that region, of the bounty offers of Congress. Their plan advocated the township system; and conditions of settlement and cultivation were to be attached to each grant of land by Congress, with penalties for noncompliance. This was known as the "Army Plan."

On June 5, 1783, Bland of Virginia, made a proposal, seconded by Hamilton, that the territory to be set aside for accounts due the soldiers, should be laid off in districts not exceeding two degrees of latitude, and three degrees of longitude each; and into townships not exceeding ____ miles square. Out of every 100,000 acres granted to the soldiers, 10,000 acres were to be reserved as common property of the United States. This was known as the "Financier's Plan." It can be readily seen that both of these plans insisted on the township system; but the "Army Plan" provided that unappropriated land was to belong to the State, would be used for local needs, and there would be no ownership of land by the Nation; while in the later plan the National domain was created.

WASHINGTON APPROVES PLAN

The Army Plan was delivered on June 16, 1783, to General Washington.

(Continued on next page)

Early Origin of Townships, Ranges and Sections

(Continued from preceding page)

and on the following day was forwarded by him to Congress. A letter from Rufus Putnam (Chief of Engineers of the Continental Army) to Washington, accompanied the petition by the Army officers. This letter stated that the officers wished the grants to be made by townships six square, or six by twelve, or six by eighteen, to be subdivided by the proprietors to six miles square, "that being the standard on which they wish all calculations to be made."

Washington approved this plan heartily, and wrote to Congress that this plan of colonization "would connect our Government with the frontiers; extend our settlements progressively, and plant a brave people as our advance post." Washington also urged the matter in person while Congress sat at Princeton. Congress, however, pleaded the incomplete cession of lands, and finally, on October 29th, stated that at that time it could not make any appropriation of land.

The second installment will appear in the next issue of California Highways and Public Works.

Bay Bridge Completes Eight Years of Operation

(Continued from page 26)

At the present time, 71 employees of the bridge operation and maintenance staff are serving in the armed forces of the United States.

RELATION TO WAR EFFORT

It is probably unnecessary to mention the importance of the Bay Bridge in connection with the war effort. Although it can never be accurately appraised, its contribution to the war is recognized and appreciated by Army and Navy officials as well as by the average citizen. Possibly its importance can be visualized by imagining the handicaps which would have been suffered by the local war industries, and therefore in the Nation's war effort, if the bridge had not been available in this time of crisis.

After the war is over and victory won, the Bay Bridge will continue to serve its peace-time function of providing an economic and cultural life line between the metropolitan areas on both sides of San Francisco Bay and contributing to the general welfare of California's citizens.

Highway Bids and Contract Awards

October 1944

CALAVERAS COUNTY Between Sandy Gulch Mill Pond and J. P. Lodge Road, about 7 miles to be surfaced with imported base material. District X, Blue Mountain Road. George French, Jr., Stockton, $49,000; R. A. Westbrook, Sacramento, $55,100; M. J. Ruddy & Son, Modesto, $56,950; J. P. Breen, Sacramento, $65,450. Contract awarded to H. Sykes, Patterson, $47,650.

HUMBOLDT COUNTY—At Benbow, a distance of about 0.1 mile, a slide area to be stabilized. District I, Route 1, Section A. Frank E. Young, Berkeley, $76,312; Scheumann & Johnson, Seattle, $80,186; C. M. Syar, Vallejo, $82,232; R. A. Farish, San Francisco, $89,043; J. Henry Harris, Berkeley, $89,986; Guerin Bros., San Francisco, $97,226; N. M. Ball Sons, Berkeley, $118,888. Contract awarded to E. B. Bishop, Orland, $69,673.

HUMBOLDT COUNTY—Between 1.5 miles east of Route 1 and Route 20, about 0.9 mile, to be graded and surfaced with imported base material. District I, Route 85, Section A. Guerin Bros., South San Francisco, $29,925; N. M. Ball Sons, Berkeley, $30,585; Scheumann & Johnson, Seattle, Washington, $33,855. Contract awarded to E. B. Bishop, Orland, $26,090.

KERN COUNTY—Between North Reservation Gate and Muroc School, about 1.0 mile to be graded, surfaced with imported surfacing material and bituminous surface treatment applied. District IX. Oswald Bros., Los Angeles, $49,408; Phoenix Construction Co., Bakersfield, $52,495; R. A. Farish, San Francisco, $55,212. Contract awarded to R. W. Hampton Co. Inc., Los Angeles, $44,359.

LASSEN COUNTY—Repairing a surfaced area with roadmixed bituminous material. District II, Honey Lake. Contract awarded to Harms Bros., Sacramento, $15,773.

MARIN COUNTY—Across Richardson Bay at Manzanita and Corte Madera Creek at Greenbrae, the bridge decks on the movable spans to be removed and replaced with steel flooring. District IV, Route 1, Section C. James H. McFarland, San Francisco, $19,970; Freethy Kimball Company, San Francisco, $21,950; Kiss Crane Co., San Pablo, $33,394; Peter Sorensen, Redwood City, $31,083. Contract awarded to Fred D. Kyle, Los Angeles, $19,533.

ORANGE COUNTY At Carbon Canyon Creek, a net length of about 0.2 mile, an existing timber bridge with concrete deck to be raised to new grade, approaches to be graded, plant-mixed surfacing to be placed, and bituminous surface treatment to be applied. District VII, Route 175, Section B. Contract awarded to Norman I. Fadel, North Hollywood, $23,552.

RIVERSIDE COUNTY Plant mixed surfacing between junction Route 26 and Palm Springs. District VIII, Route 187, Section D. Contract awarded to George A. Herz & Associates, San Bernardino, $6,270.

SAN BERNARDINO COUNTY On Tippecanoe Avenue between Third Street and Base Line road, about 1.2 miles to be graded and surfaced with plant-mixed surfacing. District VIII. E. L. Yeager, Riverside, $35,992; Olympic Contracting Co., Los Angeles, $51,191; Griffith Co., Los Angeles, $57,340. Contract awarded to Geo. Herz & Co., San Bernardino, $34,651.

SAN BERNARDINO COUNTY North of Blue Cut, between Devore and Alray, about ½ mile of creek channel to be constructed. District VIII, Route 31, Section B. L. S. Hutchinson Co., Los Angeles, $16,180; C. G. Willis & Sons, Los Angeles, $16,840; Ralph A. Bell, Sierra Madre, $17,630; Owl Truck & Construction Co., Compton, $17,760; Norman I. Fadel, North Hollywood, $35,400; J. E. Roberts, San Bernardino, $41,732; Egglestone & Root, San Bernardino, $53,600. Contract awarded to Mittry Bros. Construction Co., Los Angeles, $15,760.

SAN BERNARDINO COUNTY—Between Riverside County line and State Route 58, about 53.5 miles to be repaired by placing road mixed surfacing over portions of the existing surface and applying seal coat to existing and new surfacing. District VIII, Route 146, Sections A, B, C, D. C. R. Herring Co., Los Angeles, $44,120; R. R. Hensler, Glendale, $45,477. Contract awarded to Carson Frazzini, Tonopah, Nevada, $42,331.

VENTURA COUNTY—Between Moorpark and Chatsworth, about 0.1 mile embankments to be restored, portland cement concrete pavements to be constructed, plant-mixed surfacing to be placed, and heavy stone riprap to be placed. District VII, Route 9, Sections B, C. Nathan A. Moore, Albambra, $26,025. Contract awarded to Norman I. Fadel, North Hollywood, $15,057.

November 1944

LOS ANGELES AND VENTURA COUNTIES—At Las Flores and Big Sycamore maintenance stations, maintenance station buildings to be painted. District VII, Route 60, Sections A,A. Contract awarded to David Wein, Los Angeles, $2,080.

TULARE COUNTY—At Southern Pacific Railroad Crossing (Sharpe's Crossing) about 8 miles north of Visalia, a floodlight system to be furnished and installed. District VI, Route 132, Section B. Scott-Buttner Electric Co., Oakland, $1,496. Contract awarded to California Lead Cable Splicing Co., Los Angeles, $700.

SAN JOAQUIN COUNTY—Between Stockton and Rough and Ready Island, about 2.4 miles to be graded and surfaced with plant mixed surfacing on untreated rock base. District X. Louis Biasotti & Son, Stockton, $78,020; M. J. B. Construction Co., Stockton, $81,432; Elmer J. Warner, Stockton, $83,569; Claude C. Wood, Lodi, $102,745; R. A. Farish, San Francisco, $106,012. Contract awarded to Geo. French, Jr., Stockton, $75,253.

SAN FRANCISCO CITY AND COUNTY On Hunters Point Boulevard, Innes Avenue and Donahue Street, about 0.7 mile to be graded and paved with asphalt concrete pavement on crusher run base and on existing pavement. District IV. Chas. L. Harney, San Francisco, $49,822; Eaton & Smith, San Francisco, $56,247; A. G. Raisch Co., San Francisco, $58,400; Peter Sorenson, Redwood City, $69,229. Contract awarded to Fay Improvement Company, San Francisco, $44,369.

Doc: "Have you told Mr. Brown that he's the father of twins?"

Nurse: "Not yet. He's shaving."

State of California

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Department of Public Works

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